Construction Surveys

1. Scope

The work consists of performing all surveys, measurements, and computations required by this specification.

2. Equipment and Material

Equipment for construction surveys shall be of a quality and condition to provide the required accuracy. The equipment shall be maintained in good working order and in proper adjustment at all times. Records of repairs, calibration tests, accuracy checks, and adjustments shall be maintained and be available for inspection by the engineer. Equipment shall be checked, tested, and adjusted as necessary in conformance with manufacturer's recommendations.

Material is field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and all other items necessary to perform the work specified.

3. Quality of Work

All work shall follow recognized professional practice and the standards of the industry unless otherwise specified in section 9 of this specification. The work shall be performed to the accuracy and detail appropriate for the type of job. Notes, sketches, and other data shall be complete, recorded neatly, legible, reproducible and organized to facilitate ease in review and allow reproduction of copies for job documentation. Survey equipment that requires little or no manual recording of field data shall have survey information documented as outlined in section 9 of this specification.

All computations shall be mathematically correct and shall include information to identify the bid item, date, and who performed, checked, and approved the computations. Computations shall be legible, complete, and clearly document the source of all information used including assumptions and measurements collected.

If a computer program is used to perform the computations, the contractor shall provide the engineer with the software identification, vendor's name, version number, and other pertinent data before beginning survey activities. Computer generated computations shall show all input data including values assigned and assumptions made.

The elevations of permanent and temporary bench marks shall be determined and recorded to the nearest 0.01 foot.

The minimum requirements for placing slope stakes shall be as little as 25 feet for sharp curves, breaks in the original ground surface and at any other intermediate stations necessary to ensure accurate location for construction layout and measurement. Slope stakes and cross sections shall be perpendicular to the centerline. Significant breaks in grade shall be determined for cross sections. Distances shall be measured horizontally and recorded to the nearest 0.1 foot.

Measurements for stationing and establishing the location of structures shall be made to the nearest 0.1 foot. Measurements for elevation shall also be made to the nearest 0.1 foot.

4. Primary Control

The baselines and bench marks for primary control, necessary to establish lines and grades needed for construction, are shown on the drawings and have been located on the job site.

These baselines and bench marks shall be used as the origin of all surveys, layouts, and measurements to establish construction lines and grades. The contractor shall take all

necessary precautions to prevent the loss or damage of primary control points. Any stakes or control points lost or damaged by construction activity will be reestablished by the contractor or at contractor expense.

5. Construction Surveys

Contractor performed surveys shall consist of all work necessary for:

- establishing line and grade for all work from an NRCS established Digital Elevation Model (DEM) electronic file and X, Y, and Z coordinates indicated on the plan drawings.
- setting slope stakes for all work
- checking and any supplemental or interim staking
- establishing final grade stakes
- performing quantity surveys, measurements, and computations for progress payment
- other surveys as described in section 9 of this specification

The contractor shall immediately notify the NRCS and owner/operator of survey conflicts between plan drawings, DEM, and on site measurements which could result in conflicts with design quantities.

6. Staking

The construction staking required for the item shall be completed before work on any item starts. Construction staking shall be completed as follows or as otherwise specified in section 9 of this specification:

Slope stakes shall be placed at the intersection of the specified slopes and ground line. Slope stakes and the reference stakes for slopes shall be marked with the stationing, required cut or fill, slope ratio, and horizontal distance from the centerline or other control line.

Minimum staking requirements are as follows:

- Cross section stakes across the inset floodplain at the upstream end of each riffle (US Riffle) identifying every neat line break in grade and cut and fill requirements.
- Centerline and/or offset stakes identifying Feature locations as noted in the Plan and Profile drawing sheets (pages 5-10). Cut and fill requirements at the centerline location shall be identified.

The NRCS Technician shall be notified a minimum of 48 hours prior to initiating excavation or earthfill in order to check for adequate and accurate staking.

7. Records

All survey data shall be recorded in fully identified standard hard-bound engineering survey field notebooks with consecutively numbered pages. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, weather data, sketches, and the personnel who performed and checked the work. Electronically generated survey data and computations shall be bound, page numbered, and cross referenced in a bound field notebook containing the index for all survey activities. All work shall follow recognized professional practice.

The construction survey records shall be available at all times during the progress of the work for examination and use by the engineer and when requested, copies shall be made available. The original field

notebooks and other records shall be provided to and become the property of the owner before final payment and acceptance of all work.

Complete documentation of computations and supporting data for progress payments shall be submitted to the engineer with each invoice for payment as specified in section 9 of the specification.

8. Payment

Measurement will not be made for this item. Payment will be made at the lump sum price.

Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Payment will not be provided under this item for the purchase price of materials or equipment having a residual value.

Compensation for any item of work shown described in the contract, drawings, or special provisions, but not listed in the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

Progress payments will be based on the percent of total project work completed.

9. Special Provisions

See Attached Sheet.

10. Submittals

- The name, qualifications, and experience of the individuals to be assigned to survey tasks shall be submitted to the Contracting Officer a minimum of 15 days prior to starting work that requires contractor performed surveys.

- As-Built survey information substantiating quantities shall accompany invoices as appropriate.

9. SPECIAL PROVISIONS – CONSTRUCTION SURVEYS (MT-7)

Bid Item 1, Construction Surveys

1. This item shall include all work, equipment, and material required to complete construction surveys assuring work is to the lines and grades shown on the drawings and finished design surface as presented in the Digital Elevation Model (DEM).

2. In Section 2, EQUIPMENT AND MATERIAL, the NRCS will provide a Digital Elevation Model (DEM), in electronic *.dwg format of the finished and original ground surface. The DEM was developed using AUTOCAD Civil 3D software, Version 2014.

3. In Section 3, QUALITY OF WORK, the CONTRACTOR shall utilize the DEM to stake earthwork construction with the necessary frequency to meet construction tolerances (See MEASUREMENT AND PAYMENT SECTION under MT 104 and MT 105). This requires the work of survey grade GPS equipment.

4. In Section 3, QUALITY OF WORK, control points shall be measured and recorded at least every 3 hours and not less than once per base station setup.

5. In Section 4, PRIMARY CONTROL, Control points, otherwise described as benchmarks, are described and plotted on Sheet 2 of the drawings.

6. In Section 4, PRIMARY CONTROL, Surveys shall utilize the horizontal and vertical datums as established by NRCS and documented on Sheet 2 of the drawings.

7. In Section 6, STAKING, the NRCS will establish benchmarks, work limits, and locations for bank protection, cobble patches, cross vanes, and permanent rock plugs.

8. In Section 6, STAKING, the NRCS will NOT provide staking for excavation and earthfill work except for defining the boundaries of isolated areas where OVER-EXCAVATION is not required. These areas are termed SHALLOW CUT areas.

9. In Section 7, RECORDS, all survey documentation shall include descriptive information including, but not limited to, the UTM Zone and datum, geoid model, units utilized for horizontal coordinates and vertical datum, control points checked along with the time of reading, and elevation measured.

10. In Section 7, RECORDS, survey documentation shall be submitted via electronic files in addition to that required under this specification. All electronic files shall be compatible with AUTOCAD Civil 3D, Version 2014 with respect to drawing information and Microsoft EXCEL 2013 with respect to data tables.

Mobilization and Demobilization

1. Scope

The work consists of the mobilization and demobilization of the contractor's forces and equipment necessary for performing the work required under the contract. It does not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract. Mobilization will not be considered as work in fulfilling the contract requirements for commencement of work.

2. Equipment and material

Mobilization shall include all activities and associated costs for transportation of contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary general facilities for the contractor's operations at the site; premiums paid for performance and payment bonds including coinsurance and reinsurance agreements as applicable; and other items specified in section 4 of this specification.

Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the contract from the site; including the disassembly, removal, and site cleanup of offices, buildings, and other facilities assembled on the site specifically for this contract.

This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted, or added items of work for which the contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

3. Payment

Payment will be made as the work proceeds in accordance with the following:

Partial payments for mobilization and demobilization will be made based on the lump sum bid price as follows:

a. 25% of the amount bid for mobilization and demobilization when the Contractor has moved on-site and begun construction activities.
b. 50% of the amount bid for mobilization and demobilization when 25% of the contract amount (excluding mobilization and demobilization) has been completed.
c. 75% of the amount bid for mobilization and demobilization when 50% of the contract amount (excluding mobilization and demobilization) has been completed.
d. 100% of the amount bid for mobilization and demobilization when 100% of the contract amount has been completed.

Payment of the lump sum contract price for mobilization and demobilization will constitute full compensation for completion of the work.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

4. Special Provisions

See Attached Sheet.

5. Submittals

- Travel Plan – Submittals are to be received by the Contracting Officer a minimum of 15 days prior to mobilization.

4. SPECIAL PROVISIONS – MOBILIZATION AND DEMOBILIZATION (MT-8)

Bid Item 2, Mobilization and Demobilization

1. This item shall consist of the mobilization and demobilization of the CONTRACTOR'S forces and equipment including traffic control to perform the work required in the contract.

2. The CONTRACTOR shall thoroughly clean all equipment prior to mobilization to the project to assure that the equipment is free of weed seeds.

3. Construction Work Limits are defined on Sheet 21 of the Big Spring Creek Restoration Drawing set. All staging, stockpiling, construction, and/or other activity associated with this project shall occur within the Construction Work Limits.

4. The CONTRACTOR shall submit a project site travel plan to the CO designating temporary road locations and planned stockpile and waste pile locations. The travel plan shall also designate the destination and haul route for waste materials leaving the site.

5. The CONTRACTOR shall ensure haul roads in and out of the construction site are maintained in a clean and safe condition throughout the project. All non-paved, existing or constructed access and travel routes within the Construction Work Limits shall be reclaimed to a condition equal to that which existed prior to construction.

6. The CONTRACTOR is responsible for traffic control and safety related to trucking materials in and out of the project area. Montana DOT, Fergus County, and the City of Lewistown shall be contacted regarding needed precautions and permits.

7. Hauling on Fergus Road shall be limited to earthwork and materials that originate from or are needed for construction on the south side of the existing Big Spring Creek location.

8. A power source is identified on the Construction Work Limit Map. Arrangements for the use of power shall be made directly between the land owner, Mark Machler, and the CONTRACTOR. The supply of power is not provided as a result of this contract.

9. In Section 3 part d, completion of the contract includes acceptance of the site cleanup by the NRCS TECHNICIAN.

General Requirements

1. SCOPE

Work shall consist of furnishing all equipment and materials and performing all operations in connection with construction of the project as shown on the drawings, described in the special provisions and as staked in the field.

2. DEFINITIONS

Owner/Operator—official spokesperson for the project who enters into all contractual agreements, obtains all permits and easements necessary for construction, ensures construction in accordance with the plan drawings and specifications, and is financially responsible for the project.

Technician— Natural Resources Conservation Service (NRCS) representative who is authorized to conduct quality assurance activities. The technician makes recommendations to the owner/operator concerning changes and acceptance of the work.

Contractor— individual who has an agreement with the owner/operator to construct the project.

Excavator— individual who actually performs the excavation, soil borings, or similar construction activity.

3. SAFETY

Equipment and methods used in construction shall be in accordance with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) regulations.

The contractor shall comply with OSHA Parts 1910 and 1926, Construction Industry Standards and Interpretations. The contractor shall ensure a safe working environment and operate under a construction safety program that is in compliance with Federal, State, and local laws and regulations.

When personnel must enter confined spaces, trenches, or other excavations, the contractor shall comply with OSHA Safety and Health Standards, Part 1926, Safety and Health Regulations for Construction, Subpart P, Excavations.

A potential hazard to life and property exists from the disturbance of utilities by construction.

The excavator is responsible for calling the Utility Notification Center at least two full business days before excavation begins to ensure that all publicly-owned underground utilities are marked. The “Call Before You Dig” phone number for Montana (except for Lincoln and Flathead Counties) is 811 or 1-800-551-8344. The “Call Before You Dig” phone number for Flathead and Lincoln Counties is: 1-800-551-8344 (there is no 811 equivalent for this area). The excavator will be held responsible for damages to utilities and property if such notice is not provided.

The locate ticket number shall be provided by the excavator to the NRCS prior to the start of construction.

The owner/operator is responsible for marking private underground utilities (e.g. propane and water lines) affected by the project. In addition to buried private utilities, there may be additional buried lines for such things as oil fields and the Air Force Missile Control System.

Known utilities are shown on the plan drawings. The NRCS makes no assurances or representation of the existence or non-existence of utilities.

The Utility Notification Center and the Montana NRCS have adopted the American Public Works Association Uniform Color Code for the purpose of marking specific utilities and avoiding confusion, particularly within road right-of-way. Pink and white are the colors designated for temporary survey markings and proposed excavation limits. The Contractor and Owner/Operator shall respect and apply these colors during construction. Color code reservations are listed below:

PINK – Temporary Survey Markings
WHITE – Proposed Limits or Routes
RED – Electric Power
YELLOW – Gas, Oil, Steam, Petroleum
ORANGE – Communications
BLUE – Potable Water
GREEN – Sewers and Drains

4. PROJECT MODIFICATIONS

Project modifications to the plan drawings and specifications must be approved by the NRCS and MT Fish Wildlife and Parks prior to implementation. Differing site conditions, weather, materials, workmanship, value engineering proposals, or other issues may justify project modifications.

5. ENVIRONMENTAL CONSIDERATIONS

Construction shall be carried out in a manner which minimizes water, land, and air pollution in compliance with Federal, State, and local laws and regulations. The MT Fish, Wildlife, and Parks is responsible to secure all necessary permits prior to construction unless otherwise directed in the Special Provisions.

One or more permits may be applicable on a project. These permits may include, but are not limited to:

A. Montana Stream Protection Act (SPA-124 Permit)

B. Montana Floodplain and Floodway Management Act (Floodplain Permit)

C. Federal Clean Water Act (Section 404 Permit)

D. Federal Rivers and Harbors Act (Section 10 Permit)

E. Short-Term Water Quality Standard for Turbidity (318 Authorization Permit)

F. Montana Land-Use License or Easement on Navigable Waters

The contractor is responsible for the identification of hazardous materials discovered during construction. The contractor shall immediately notify the NRCS and owner/operator of the presence of hazardous materials. The owner/operator is responsible for the proper handling and disposal of these materials.

6. CULTURAL RESOURCES

NRCS field personnel have reviewed the project area for cultural resources (archaeological and historic). However, the possibility exists for accidental discoveries during construction. If cultural material (cut or burned bones, fire cracked rocks, projectile points, foundations, fire hearths, etc.) is discovered by the contractor, owner/operator or NRCS technician, the work must stop. The NRCS technician shall contact the NRCS Cultural Resource Specialist for further instructions and establish the actions necessary to assess the cultural resources. Work shall not resume within 300 feet of the discovery until the owner/operator receives written notification from the NRCS technician. The notification may contain special provisions for protecting the cultural resource.

7. QUALITY CONTROL/QUALITY ASSURANCE

The contractor shall be responsible for quality control. A system shall be developed and implemented by which to achieve the specified quality of work, material, and equipment.

Quality assurance shall be provided by the Technician.

8. ADDITIONAL RESPONSIBILITIES

The contractor is obligated to immediately notify the NRCS and owner/operator of construction problems in order to facilitate practical, functional, and cost-effective project modifications. These problems may be associated with differing site conditions, construction staking and measurements, conflicts between plan drawings and specifications, defective materials, or other issues.

9. MEASUREMENT AND PAYMENT

Compensation for any item of work shown on the drawings or described in this specification or special provisions will be considered incidental to and included in the pay items listed on the bid schedule.

10. REFERENCES

The following abbreviations will be used in the construction and material specifications to designate the organizations who publish the referenced "Standard Specifications":

ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
ACI	American Concrete Institute
ANSI	American National Standard Institute (American Society of Mechanical Engineers)
AASHTO	American Association of State Highway and Transportation Officials

The following abbreviations are used to designate technical or regulatory agencies:

NRCS	United States Department of Agriculture, Natural Resources Conservation Service
OSHA	United States Department of Labor, Occupational Safety and Health Administration
EPA	United States Environmental Protection Agency
MFWP	Montana Fish Wildlife and Parks
MDEQ	Montana Department of Environmental Quality

11. SPECIAL PROVISIONS

See Attached Sheet.

12. SUBMITTALS REQUIRED

10. SPECIAL PROVISIONS - GENERAL REQUIREMENTS (MT-100)

1. This item shall include all work, equipment, and material as required in this specification.

2. In Section 2, DEFINITIONS, the following shall apply:

   - Owner/Project Manager = Montana Fish, Wildlife, and Parks (MT FWP). Paul Valle will be the Contracting Officer (CO). The on-site Contract Officer's Representative (COR) will be designated by MT FWP.
   - Technician = NRCS Technician = To be designated by NRCS.
   - Contractor = contractor hired under construction contract with MT FWP.
   - Excavator = Designated by the Contractor

3. In Section 5, ENVIRONMENTAL CONSIDERATIONS, the following permits have been obtained for the project and are enclosed in the bid package for review. The CONTRACTOR will be required to operate under the terms and conditions of these permits:

   - 404 Permit (Clean Water Act) – issued by US Army Corps of Engineers
   - 124 Permit (MT Natural Streambed and Land Preservation Act) – issued by MT FWP
   - 318 Authorization (MT Water Quality Act) – issued by MT DEQ
   - 401 Water Quality Certification – waived by MT DEQ
   - Floodplain Development Permit (MT Floodplain Mgt Act) – issued by Fergus County Commissioners
   - Floodplain Development Permit (MT Floodplain Mgt Act) – issued by City of Lewistown

4. In Section 3.1.6 of the GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, Quality Assurance shall be the responsibility of the Technician.

5. In Section 3, Safety, in addition to Section 10.1 of the GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, the Contractor shall comply with Natural Resources Conservation Service Supplement to OSHA Parts 1910 and 1926 included in Pages 5-9 of this Special Provision.

NATURAL RESOURCES CONSERVATION SERVICE SUPPLEMENT TO OSHA PARTS 1910 AND 1926

CONSTRUCTION INDUSTRY STANDARDS AND INTERPRETATIONS

The Contractor shall comply with OSHA (Occupational Safety and Health Administration) Parts 1910 and 1926, Construction Industry Standards and Interpretations, and with this supplement.

Requests for variances or waiver from this supplement are to be made to the Contracting Officer in writing supported by evidence that every reasonable effort has been made to comply with the contractual requirements. A written request for a waiver or a variance shall include--

(1) Specific reference to the provision or standard in question;

(2) An explanation as to why the waiver is considered justified; and

(3) The Contractor's proposed alternative, including technical drawings, materials, or equipment specifications needed to enable the Contracting Officer to render a decision.

No waiver or variance will be approved if it endangers any person. The Contractor shall not proceed under any requested revision of provision until the Contracting Officer has given written approval. The Contractor is to hold and save harmless the Natural Resources Conservation Service free from any claims or causes of action whatsoever resulting from the Contractor or subcontractors proceeding under a waiver or approved variance.

Copies of OSHA Parts 1910 and 1926, Construction Industry Standards and Interpretations, may be obtained from: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

1.0 GENERAL CONTRACTOR REQUIREMENTS:

1.1 SAFETY PROGRAM. Each Contractor is to demonstrate that he or she has facilities for conducting a safety program commensurate with the work under contract. The Contractor is to submit in writing a proposed comprehensive safety program to the Contracting Officer for approval before the start of construction operations. The program is to specifically state what provisions the Contractor proposes to take for the health and safety of all employees, including subcontractors and rental equipment operators. The program shall be site specific and provide details relevant to the work to be done, the hazards associated with the work, and the actions that will be necessary to minimize the identified hazards.

1.2 PRECONSTRUCTION SAFETY MEETING. Representatives for the Contractor are to meet with the Contracting Officer (CO) or the CO's representative before the start of construction to discuss the safety program and the implementation of all health and safety standards pertinent to the work under this contract.

1.3 JOINT SAFETY POLICY COMMITTEE. The Contractor or designated on-site representative is to participate in monthly meetings of a joint Safety Policy Committee,

composed of the Natural Resources Conservation Service (Contracting Local Organization in locally awarded contracts) and Contractor supervisory personnel. At these meetings the Contractor's project manager and the Contracting Officer will review the effectiveness of the Contractor's safety effort, resolve current health and safety problems, and coordinate safety activities for upcoming work.

1.4 SAFETY PERSONNEL. Each Contractor is to designate a competent supervisory employee satisfactory to the Contracting Officer to administer the safety program.

1.5 SAFETY MEETINGS. A minimum of one "on-the-job" or "toolbox" safety meeting is to be conducted each week by all field supervisors or foremen and attended by mechanics and all construction personnel at the jobsite. The Contractor is to also conduct regularly scheduled supervisory safety meetings at least monthly for all levels of job supervision.

1.6 SAFETY INSPECTION. The Contractor shall perform frequent and regular safety inspections of the jobsite, materials, and equipment, and shall correct deficiencies.

1.7 FIRST AID TRAINING. Every Contractor foreman's work crew must include an employee who has a current first aid certificate from the Mine Safety and Health Administration, American Red Cross, or other state-approved organization.

1.8 REPORTS. Each Contractor is to maintain an accurate record of all job-related deaths, diseases, or disabling injuries. The records shall be maintained in a manner approved by the Contracting Officer. A copy of all reports is to be provided to the Contracting Officer. All fatal or serious injuries are to be reported immediately to the Contracting Officer, and every assistance is to be given in the investigation of the incident, including submission of a comprehensive narrative report to the Contracting Officer. Other occurrences with serious accident potential, such as equipment failures, slides, and cave-ins, must also be reported immediately. The Contractor is to assist and cooperate fully with the Contracting Officer in conducting accident investigations. The Contracting Officer is to be furnished all information and data pertinent to investigation of an accident.

1.9 CERTIFICATION OF INSURANCE. Contractors are to provide the Contracting Officer or his or her authorized representative with certificates of insurance before the start of operations indicating full compliance with State Worker's Compensation statutes, as well as other certificates of insurance required under the contract.

2.0 FIRST AID AND MEDICAL FACILITIES:

2.1 FIRST AID KITS. A 16-unit first aid kit approved by the American Red Cross is to be provided at accessible, well-identified, locations at the ratio of at least 1 kit for each 25 employees. The first aid kits are to be moisture proof and dust tight, and the contents of the kits are to be replenished as used or as they become ineffective or outdated.

2.2 EMERGENCY FIRST AID. At least one employee certified to administer emergency first aid must be available on each shift and duly designated by the Contractor to care for injured employees. The names of the certified employees shall be posted at the jobsite.

2.3 COMMUNICATION AND TRANSPORTATION. Prior to the start of work, the Contractor is to make necessary arrangements for prompt and dependable communications,

transportation, and medical care for injured employees. At least one stretcher and two blankets shall be readily available for transporting injured employees.

2.4 FIRST AID AND MEDICAL REPORTS. The Contractor is to maintain a record system for first aid and medical treatment on the jobsite. Such records are to be readily available to the Contracting Officer and are to include--

(a) A daily treatment log listing chronologically all persons treated for occupational injuries and illnesses;

(b) Cumulative record of injury for each individual;

(c) Monthly statistical records of occupational injuries, classified by type and nature of injury; and

(d) Required records for worker's compensation.

2.5 SIGNS AND DIRECTIONAL MARKINGS. Adequate identification and directional markers are to be provided to readily denote the location of all first aid stations.

2.6 EMERGENCY LISTING. A listing of telephone numbers and addresses of doctor, rescue squad, hospital, police, and fire departments is to be provided at all first aid locations.

3.0 PHYSICAL QUALIFICATIONS OF EMPLOYEES:

3.1 GENERAL REQUIREMENTS. Persons employed throughout the contract are to be physically qualified to perform their assigned duties. Employees must not knowingly be permitted or required to work while their ability or alertness is impaired by fatigue, illness, or any other reason that may jeopardize themselves or others.

3.2 HOIST OPERATORS. Operators of cranes, cableways, and other hoisting equipment shall be examined annually by a physician and provided with a certification stating that they are physically qualified to safely operate hoisting equipment. The Contractor is to submit a copy of each certification to the Contracting Officer.

3.3 HEAVY EQUIPMENT OPERATORS. It is recommended that operators of trucks and heavy construction equipment be given physical examinations to determine if they are physically qualified to perform their assigned work without endangering themselves or others.

3.4 MOTOR VEHICLE OPERATORS. Operators of motor vehicles engaged primarily in the transportation of personnel are to be 18 years of age or older and have a valid state operator's permit or license for the equipment being operated. The operators must have passed a physical examination administered by a licensed physician within the past year showing that they are physically qualified to operate vehicles safely.

4.0 PERSONAL PROTECTIVE EQUIPMENT:

4.1 HARDHAT AREAS. The entire jobsite, with the exception of offices, shall be considered a hardhat area. All persons entering the area are, without exception, required to

wear hardhats. The Contractor shall provide hardhats for visitors entering hardhat areas.

4.1.1 LABELS. Hardhats shall bear a manufacturer's label indicating design compliance with the appropriate ANSI (American National Standards Institute) standard.

4.2 POSTING. Signs at least 3 by 4 feet worded as follows with red letters (minimum 6 inches high) and white background shall be erected at access points to designated hardhat areas:

CONSTRUCTION AREA - HARDHATS REQUIRED BEYOND THIS POINT

These signs are to be furnished and installed by the Contractor at entries to shops, construction yards, and job access points.

4.3 SAFETY GOGGLES (DRILLERS)

4.3.1 DRILLERS AND HELPERS. Drillers and helpers operating pneumatic rock drills must wear protective safety goggles.

5.0 MACHINERY AND MECHANIZED EQUIPMENT:

5.1 SAFE CONDITION. Before any machinery or mechanized equipment is initially used on the job, it must be inspected and tested by qualified personnel and determined to be in safe operating condition and appropriate for the intended use. Operators shall inspect their equipment prior to the beginning of each shift. Any deficiencies or defects shall be corrected prior to using the equipment. Safety equipment, such as seatbelts, installed on machinery is to be used by equipment operators.

5.2 TAGGING AND LOCKING. The controls of power-driven equipment under repair are to be locked. An effective lockout and tagging procedure is to be established, prescribing specific responsibilities and safety procedures to be followed by the person or persons performing repair work. Mixer barrels are to be securely locked out before permitting employees to enter them for cleaning or repair.

5.3 HAUL ROADS FOR EQUIPMENT

5.3.1 ROAD MAINTENANCE. The Contractor shall maintain all roadways, including haul roads and access roads, in a safe condition so as to eliminate or control dust and ice hazards. Wherever dust is a hazard, adequate dust-laying equipment shall be available at the jobsite and utilized to control the dust.

5.3.2 SINGLE-LANE HAUL ROADS. Single-lane haul roads with two-way traffic shall have adequate turnouts. Where turnouts are not practical, a traffic control system shall be provided to prevent accidents.

5.3.3 TWO-WAY HAUL ROADS. On two-way haul roads, arrangements are to be such that vehicles travel on the right side wherever possible. Signs and traffic control devices are to be employed to indicate clearly any variations from a right-hand traffic pattern. The road shall be wide enough to permit safe passage of opposing traffic, considering the type of hauling equipment used.

5.3.4 DESIGN AND CONSTRUCTION OF HAUL ROADS. Haul road design criteria and

drawings, if requested by the Contracting Officer, are to be submitted for approval prior to road construction. Sustained grades shall not exceed 12 percent and all curves shall have open-sight line with as great a radius as practical. All roads shall be posted with curve signs and maximum speed limits that will permit the equipment to be stopped within one-half of the minimum sight distance.

5.3.5 OPERATORS. Machinery and mechanized equipment shall be operated only by authorized qualified persons.

5.3.6 RIDING ON EQUIPMENT. Riding on equipment by unauthorized personnel is prohibited. Seating and safety belts shall be provided for the operator and all passengers.

5.3.7 GETTING ON OR OFF EQUIPMENT. Getting on or off equipment while the equipment is in motion is prohibited.

5.3.8 HOURS OF OPERATION. Except in emergencies, an equipment operator shall not operate any mobile or hoisting equipment for more than 12 hours without an 8-hour rest interval away from the job.

5.4 POWER CRANES AND HOISTS (TRUCK CRANES, CRAWLER CRANES, TOWER CRANES, GANTRY CRANES, HAMMERHEAD CRANES, DERRICKS, CABLEWAYS, AND HOISTS)

5.4.1 POSTING FOR HIGH VOLTAGE LINES. A notice of the 10-foot (or greater) clearance required by OSHA 1926.550, Subpart N, shall be posted in the operator's cab of cranes, shovels, boom-type concrete pumps, backhoes, and related equipment.

5.4.2 SAFETY HOOKS. Hooks used in hoisting personnel or hoisting loads over construction personnel or in the immediate vicinity of construction personnel shall be forged steel equipped with safety keepers. When shackles are used under these conditions, they shall be of the locking type or have the pin secured to prohibit turning.

5.5 ROLLOVER PROTECTIVE STRUCTURES (ROPS)

5.5.1 ROLLOVER PROTECTIVE STRUCTURES. OSHA 1926, Subpart W, Overhead Protection, Sections 1001 and 1002 are applicable regardless of the year in which the equipment was manufactured and regardless of the struck capacity of the equipment.

5.5.2 EQUIPMENT REQUIRING ROPS. The requirement for ROPS meeting 5.5.1 above applies to crawler and rubber-tired tractors such as dozers, push-and-pull tractors, winch tractors, tractors with backhoes, and mowers; off-highway, self-propelled, pneumatic-tired earthmovers, including scrapers, motor graders and loaders; and rollers, compactors, water tankers (excluding trucks with cabs). These requirements shall also apply to agricultural and industrial tractors and similar equipment.

5.5.3 EQUIPMENT REQUIRING SEATBELTS. The requirements for seatbelts as specified in OSHA Subpart 0, Motor Vehicles, Mechanized Equipment, and Marine Operations, Section 1926.602 shall also apply to self-propelled compactors and rollers, and rubber-tired skid-steer equipment.

Clearing, Grubbing, Structure Removal

1. SCOPE

The work shall consist of the clearing and grubbing of designated areas by removal and disposal of trees, snags, logs, stumps, shrubs and rubbish, and the removal, salvage and disposal of structures (including fences) from the designated areas.

2. PROTECTION OF EXISTING VEGETATION

Trees and other vegetation designated to remain undisturbed shall be protected from damage throughout the duration of the construction period. Any damages resulting from the contractor's operations or neglect shall be repaired by the contractor.

Earth fill, stockpiling of materials, vehicular parking, and excessive foot or vehicular traffic shall not be allowed within the drip line of vegetation designated to remain in place. Vegetation damaged by any of these or similar actions shall be replaced with viable vegetation of the same species, similar condition, and like size.

Any cuts, skins, scrapes, or bruises to the bark of the vegetation shall be carefully trimmed and local nursery accepted procedures used to seal damaged bark.

Any limbs or branches one inch or larger in diameter that are broken, severed, or otherwise seriously damaged during construction shall be cut off at the base of the damaged limb or branch flush with the adjacent limb or tree trunk. All roots one inch or larger in diameter that are cut, broken, or otherwise severed during construction operations shall have the end smoothly cut perpendicular to the root. Roots exposed during excavation or other operations shall be covered with moist earth or backfilled as soon as possible to prevent the roots from drying out.

3. MARKING

The limits of the areas to be cleared and grubbed will be marked by means of stakes, flags, tree markings or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

Each structure or structure part to be removed or the area where all structures are to be removed, will be marked by means of stakes, flags, painted markers or other suitable methods.

4. REMOVAL

All trees not marked for preservation and all snags, logs, brush, stumps and rubbish shall be removed from within the limits of the marked areas. Unless otherwise specified, all stumps, roots and root clusters having a diameter of one inch or larger shall be grubbed out to a depth at least two feet below subgrade elevation for concrete structures and one foot below the ground surface at embankment sites and other designated areas.

All structures designated for removal in the contract shall be removed to the specified extent and depth.

5. SALVAGE

Structures or structure parts that are designated to be salvaged shall be carefully removed and neatly placed in the specified or approved storage location. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly and systematically match marked with paint before disassembly. All connectors and other parts shall be marked to indicate their proper

location within the structure and shall be fastened to the appropriate structural member or packed in suitable containers. Material from fences designated to be salvaged shall be placed outside the work area on the property on which the fence was originally located. Fence wire shall be rolled into uniform rolls of suitable size and neatly piled with other salvaged materials. Posts and rails shall be neatly stacked.

6. DISPOSAL OF REFUSE MATERIALS

All materials removed from the cleared and grubbed or structure removal areas shall be burned or buried at locations shown on the drawings or as specified in the special provisions.

All burning operations shall be subject to all public laws, codes, and restrictions governing such operations. The contractor shall be responsible for obtaining all required permits for burning and for any damage to life and/or property caused by fires resulting from his operations.

All noncombustible materials removed from the area shall be buried at approved locations or removed from the site. Materials buried at the work site shall have a minimum earth cover of two feet and the backfilled surface shall be smoothed and graded.

7. MEASUREMENT AND PAYMENT
(Used only if applicable)

Measurement will not be made for this item. Payment will be made at the lump sum price.

Progress payments will be based on the percent of total project work completed.

Payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

8. SPECIAL PROVISIONS

See Attached Sheet.

9. SUBMITTALS REQUIRED

8. SPECIAL PROVISIONS – CLEARING, GRUBBING, STRUCTURE REMOVAL (MT-101)

Bid Item 3, Clearing and Grubbing

1. This item shall consist of all clearing and grubbing and material salvage required to construct the project to the lines and grades shown on the drawings.

2. In Section 2, PROTECTION OF EXISTING VEGETATION, staging area locations for equipment shall be pre-approved by the Owner.

3. In Section 3, MARKING, the NRCS TECHNICIAN will clearly mark trees to remain undisturbed during construction. It is the Contractor's responsibility to limb trees necessary for safe construction operations, and to alert the NRCS TECHNICIAN if safety concerns exist due to the remaining trees.

4. In Section 4, REMOVAL, stumps, roots, and root clusters shall only be removed where required for channel and/or bank treatment construction. Otherwise, stumps, roots, and root clusters shall remain in the ground to maintain floodplain and/or bank stability. Stump tops shall be cut to within 12 inches of the finished ground surface.

5. In Section 4, REMOVAL, concrete pieces and streambank rubble buried in the existing streambank, shall NOT be removed unless located in areas planned for excavation. Concrete and rubble located in areas planned for fill shall be left undisturbed.

6. In Section 4, REMOVAL, fences within the Construction Work Limits shall be removed unless marked for preservation by the NRCS TECHNICIAN.

7. In Section 5, SALVAGE, woody slash and branch material meeting 1"-8" diameter and 4 foot minimum length criteria shall be limbed and stockpiled for use within Type II Bank Protection areas.

8. In Section 5, SALVAGE, locations for stockpiled salvage material shall be within Possible Stockpile Areas as designated on the Construction Work Limit map or be pre-approved by the OWNER.

9. In Section 6, DISPOSAL OF REFUSE MATERIALS, all non-combustible materials shall be removed from the construction site and disposed of by the contractor.

Pollution Control

1. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air during construction operations.

2. MATERIALS

All materials furnished shall meet the requirements in the Special Provisions.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The Contractor shall obtain appropriate Montana Storm Water Discharge Permit(s) (MPDES) from the Montana Department of Environmental Quality (DEQ) when areas of disturbance exceed 1 acre in size and pose a threat for discharge to State Waters. A permit(s) is required in cases where potential water and sediment discharge can: a) occur across property boundaries, b) flow into public rights-of-way or c) enter channels with defined bank and streambed characteristics. A permit application requires development of a Storm Water Pollution Prevention Plan (SWPPP) and application fee.

Appropriate application of erosion and sediment control measures are specified as follows:

Staging of Earthwork Activities--The excavation and moving of soil materials shall be scheduled so as to minimize the size of areas disturbed and susceptible to erosion.

Seeding--Seedings to protect disturbed areas shall be done as specified on the drawings or in the Special Provisions.

Mulching--Mulching shall be used to provide temporary protection to soil surfaces from erosion.

Diversions--Diversions shall be used to divert water away from work areas, limit contribution of clean water to the site, control flow length and erosive nature of uncontrolled runoff, and/or to collect runoff from work areas for treatment and safe disposition.

Stream Crossings--Properly sized culverts or bridges shall be used where equipment must cross streams.

Sediment Basins--Sediment basins shall be used to settle and filter out sediment from eroding areas in order to protect properties and streams below the construction site.

Sediment Filters--Straw bale filters, straw wattles, coconut rolls or geotextile sediment fences shall be used to trap sediment from areas of limited runoff. Straw bale filters and geotextile sediment fence shall be anchored into the ground a minimum of 6 inches in order to prevent erosion under or around them. Straw wattles and coconut rolls shall be set in the ground a minimum of 3 inches and staked according to manufacturers' guidelines.

Waterways--Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

Other--Additional protection measures as specified in the Special Provisions or as required Federal, State, or local government regulations.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of

chemical pollutants (such as drained lubricating or transmission fluids, greases, oils, soaps, asphalt, etc.) produced as a by-product of the project's work. Pollutants shall be disposed of without causing pollution and in accordance with appropriate State and Federal regulations.

Sanitary facilities such as pit toilets, chemical toilets, or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. Facility contents shall be disposed of without causing pollution.

5. AIR POLLUTION

The burning of brush or slash or disposal of other materials shall adhere to State and local regulations.

Fire prevention measures shall be taken to prevent the start or the spreading of fires which result from construction activities. Fire breaks or guards shall be constructed and maintained at locations shown on the drawings or as specified in the Special Provisions.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to suppress dust. All dust control methods shall ensure safe construction operations at all times. If chemical dust suppressants are applied, the material shall be a commercially available product specifically designed for dust suppression and the application shall follow manufacturer’s requirements and recommendations. A copy of the product data sheet and manufacturer’s recommended application procedures shall be provided to the Technician five working days before the first application.

6. MAINTENANCE, REMOVAL, AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as nearly original conditions as practicable.

7. MEASUREMENT AND PAYMENT

(Used only if applicable)

For items of work for which specific unit prices are established, each item will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price for that item. For items of work for which specific lump sum prices are established, payment will be made at the lump sum price.

Progress payments will be based on the percent of total project work completed.

Payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

8. SPECIAL PROVISIONS

See Attached Sheet.

9. SUBMITTALS REQUIRED

- MT DEQ Letter of Confirmation upon receiving the NOI Package
- SWPPP

Submittals are to be received by the Contracting Officer a minimum of 15 days prior to the start of construction.

8. SPECIAL PROVISIONS – POLLUTION CONTROL (MT-102)

Bid Item 4, Pollution Control

1. This item shall consist of all work required by the Contractor to prevent water and air pollution during construction.

2. In Section 3, EROSION AND SEDIMENT CONTROL, a Notice of Intent (NOI) Package shall be developed by the CONTRACTOR and submitted to the MT DEQ. The NOI Package shall include a completed NOI form, Storm Water Pollution Prevention Plan (SWPPP), and application fee. A copy of the MT DEQ's standard response letter indicating the NOI package has been received shall be submitted to the Contracting Officer prior to initiation of construction.

3. In Section 3, EROSION AND SEDIMENT CONTROL, specified practices and treatments identified in the SWPPP for preventing pollution during construction shall be implemented and in-place prior to excavation or stockpiling of earthen materials.

4. In Section 3, EROSION AND SEDIMENT CONTROL, the CONTRACTOR shall be responsible determining the necessity for and obtaining a General Permit for Construction Dewatering. This permit is authorized under the Montana Pollutant Discharge Elimination System and serviced by MT DEQ.

5. In Section 3, EROSION AND SEDIMENT CONTROL, when stockpiling, sediment laden drain water shall be prevented from discharging into the active flow of Big Spring Creek.

6. In Section 3, EROSION AND SEDIMENT CONTROL, all disturbed areas, including staging, roads and stockpile areas, shall be reclaimed through seedbed preparation and seeding according to Broadcast Seeding Plan MT342-JS1-B or Drill Seeding Plan MT342-JS1-D as specified on Figure 1 of these specifications. Payment for this work is included in Bid Items 25 and 26, Broadcast Seeding, and Drill Seeding, respectively.

7. In Section 4, CHEMICAL POLLUTION, construction equipment shall be kept in good working order, and free of oil, hydraulic fluid, and diesel fuel leaks.

8. In Section 6, MAINTENANCE, REMOVAL, AND RESTORATION, the project site shall be cleaned up, with all refuse, remaining stockpiles, and un-used materials removed from the project site. Site cleanup shall be approved by the NRCS Technician prior to demobilization of equipment required for this item.

Removal and Control of Water

1. SCOPE

The work shall consist of the removal of surface water and groundwater as needed to perform the required construction in accordance with the drawings, specifications and special provisions. It shall include: (1) building and maintaining all necessary temporary impounding works, channels, irrigation water bypasses, and diversions, (2) furnishing, installing and operating all necessary pumps, piping and other facilities and equipment, and (3) removing all such temporary works and equipment after they have served their purposes.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, flumes, sumps, and other temporary diversion and protective works needed to divert stream flow and other surface water through, around, and away from the construction site while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainageway in which its headworks are located.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches and other parts of the construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction works. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps, casings, well points, and other equipment needed to perform the dewatering as specified. Dewatering methods that cause a loss of fines from foundation areas will not be permitted.

4. DEWATERING BORROW AREAS

Unless otherwise specified in the special provisions, the Contractor shall maintain the borrow areas in drainable condition. Otherwise, the contractor shall provide for timely and effective removal of surface and groundwaters that accumulate from any source. Borrow material shall be processed as necessary to achieve proper and uniform moisture content for placement.

5. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized. The provisions of the National Pollution Discharge Elimination System (NPDES) regulations for construction sites, enacted by EPA shall be addressed. Operations shall also conform to regulations established by the U.S. Army Corps of Engineers (USACOE) and the Montana Department of Environmental Quality (DEQ), if applicable.

6. REMOVAL OF TEMPORARY WORKS

After the temporary works have served their purposes, the Contractor shall remove or level and grade them to the extent required to present a sightly appearance. Care will be taken to prevent any obstruction of the flow of water or any other interference with the operation of, or access to, the permanent works.

Except as otherwise specified, abandonment of temporary wells shall conform to all Federal and State regulations. Abandoned wells must be completely filled with concrete or grout to within the last 3 feet of

the surface. The last 3 feet shall be filled in with naturally occurring soils.

7. MEASUREMENT AND PAYMENT
(Used only if applicable)

For items of work for which specific unit prices are established, each item will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price for that item. For items of work for which specific lump sum prices are established, payment will be made at the lump sum price.

Progress payments will be based on the percent of total project work completed.

Payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

8. SPECIAL PROVISIONS

See Attached Sheet.

9. SUBMITTALS REQUIRED

- Dewatering Plan - to be received by the Contracting Officer a minimum of 15 days prior to construction for which dewatering is needed.

8. SPECIAL PROVISIONS – REMOVAL AND CONTROL OF WATER (MT-103)

Bid Item 5, Removal and Control of Water

1. This item shall consist of removal and/or control of all surface and subsurface water regardless of the source as required to construct the works of improvement under stable conditions.

2. In Section 2, DIVERTING SURFACE WATER, stream flow shall be diverted around the immediate construction area by means of cofferdams or other methods approved by the NRCS TECHNICIAN prior to installation.

3. In Section 3, DEWATERING THE CONSTRUCTION SITE, complete removal of standing water within the construction area is not required. Reduction of water levels will be required where surfaces for placement of erosion control fabrics and soil fill are submerged. Reduction of water levels may also be necessary to achieve specified toe depths for woody slash, branch, and log materials and/or prevent floatation during installation.

4. In Section 6, REMOVAL OF TEMPORARY WORKS, the CONTRACTOR shall remove the temporary works from the bankfull channel and inset floodplain.

5. The peak flowrate measured between October 1st and April 15th, at the stream gage located across from the Lewistown Water Treatment Plant are as follows:

Water Year		Peak Flowrate, (cfs) Oct 1 – Feb 29	Date		Peak Flowrate, (cfs) Mar 1 – Apr 15	Date
2010		170	Nov 10		206	Mar 7
2011		230	Feb 16		890	Apr 1
2012		221	Feb 24		324	Mar 5
2013		168	Oct 16		200	Mar 15
2014		170	Oct 17		496	Mar 10

Daily flow records are available from MT FWP, Lewistown Field Office by request. The bankfull flow computed for Big Springs Creek is 460 cubic feet per second.

(Continued on Page 2)

Water Table Measurements were taken during subsurface investigations for the project design. The following water surface elevations were measured at the Test Pit locations shown on the Drawings.

Date of Investigation: April 29, 2012

Location	Depth to Water Table, feet	Water Table Elevation
Test Pit 1	7.5	3883.1
Test Pit 2	6.5	3880.6
Test Pit 3	3.5	3881.1

Date of Investigation: February 26, 2015

Location	Depth to Water Table, feet	Water Table Elevation
Test Pit 3A	9.47	3882.0
Test Pit 4A	10.03	3881.4
Test Pit 5A	5.47	3882.0
Test Pit 6A	5.46	3881.3
Test Pit 7A	5.52	3880.8

6. In Section 9, SUBMITTALS REQUIRED, the CONTRACTOR shall furnish to the Contracting Officer, in writing, his/her plan for dewatering. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

Excavation

1. SCOPE

The work shall consist of the excavation required by the drawings, specifications and special provisions, as well as disposal of the excavated materials.

2. CLASSIFICATION

Unless otherwise specified in the special provisions, all excavation will be common.

Excavation will be classified as common excavation or rock excavation in accordance with the following definitions or will be designated as unclassified.

Common excavation shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors. Common excavation shall also include excavated material that can be dumped into place or loaded onto hauling equipment by means of excavators having a rated capacity of one cubic yard or larger. The excavators shall be equipped with attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials, the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than 1 cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation. Though, the presence of isolated boulders or rock fragments larger than one cubic yard in size will not, in itself, be sufficient cause to change the classification of the surrounding material.

Excavation will be classified according to the above definitions by the Technician, based on their judgment of the character of the materials and the site conditions.

For the purpose of this classification, the following definitions shall apply:

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of 250 or greater net horsepower (at the flywheel) unless otherwise specified in the special provisions.

Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of at least l2 cubic yards.

Pusher tractor shall be defined as a track-type tractor having a power rating of 250 or greater net horsepower (at the flywheel) equipped with appropriate attachments.

3. UNCLASSIFIED EXCAVATION

Items shall be designated as "Unclassified Excavation" when classifications as defined in Section 2 of this specification do not apply. “Unclassified Excavation” encompasses all materials encountered regardless of their nature or the manner in which they are removed.

4. STRIPPING

Stripping consists of excavating the top layer of soil which contains vegetation, roots and other undesirable organic matter. Stripping is required at all sites upon which embankments and fills are to be constructed and at required excavations and borrow areas required for the proper installation of the work.

Stripping of Base for Embankments for Dams, Dikes, and Canals

Areas to be covered by embankments and fills shall be stripped of all vegetation, and the topsoil removed to sufficient depth to expose subsoil reasonably free of roots and other organic matter. All slopes within the limits of foundations and abutments, except pipe trenches, shall be excavated to slopes not steeper than 1:1 unless otherwise indicated on the drawings. The foundation shall be cleared of all loose unconsolidated material to provide a firm base.

Stripping Borrow Areas and Required Excavations

Required excavations and areas from which borrow materials are to be obtained shall be stripped of all vegetation, and topsoil shall be removed to sufficient depth to expose subsoil reasonably free of roots and other organic matter.

Use of Materials from Stripping

Materials which are suitable for spreading over disturbed areas after construction has been completed shall be stockpiled and subsequently spread as directed by the Technician.

Materials suitable for use in construction of the required earth fill shall be used as directed by the Technician.

Unsuitable and/or excess materials shall be wasted as directed by the Technician.

The suitability of materials for specific purposes will be determined by the Technician.

5. BLASTING

A Montana Construction Blasters License shall be required of the person directing and supervising the blasting operation. This includes transportation, handling, storage, and use of dynamite and other explosives. Material Safety Data Sheets (MSDS) for dynamite and other explosive materials shall be provided to the Technician prior to the blasting operation.

Blasting shall be done in such a way as to prevent damage to the work or unnecessary fracturing of the foundation and shall conform to any requirements (such as a blasting plan) noted in the special provisions.

6. USE OF EXCAVATED MATERIALS

To the extent they are needed, all suitable materials from the specified excavations shall be used in the construction of required permanent earth fill or rock fill. The suitability of materials for specific purposes will be determined by the Technician. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

7. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of by the Contractor at sites of his or her own choosing away from the site of the work or as shown on the drawings. The designated waste site shall be approved by the owner/operator.

8. EXCAVATION LIMITS

Excavations shall comply with OSHA Construction Industry Standards (29CFR Part 1926) Subpart P, Excavations, Trenching, and Shoring.

All excavations shall be completed and maintained in a safe and stable condition through the total construction phase. Excavated surfaces too steep to be safe and stable shall be supported as necessary to safeguard the work and workers, to prevent

sliding or settling of the adjacent ground, and to avoid damaging existing improvements. Structure and trench excavations shall be completed to the specified elevations and to sufficient length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work. Bracing and supports, when needed, shall be in place before any concrete, pipe, structure or earth fill is placed within the limits of the excavation.

Excavations outside the lines and limits shown on the drawings or specified herein required to meet safety requirements shall be the responsibility of the contractor in constructing and maintaining a safe and stable excavation.

9. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified earth fills, additional materials shall be obtained from borrow areas approved by the Technician, as agreed-to by the owner/operator.

Borrow pits shall be excavated and finally dressed in a manner to eliminate unstable side slopes or other hazardous conditions**,** blend with the existing topography, prevent ponding, and provide drainage.

10. OVER-EXCAVATION

Unless otherwise approved by the Technician, excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete. Rock surfaces shall be thoroughly cleaned and de-watered prior to placement of the concrete. Concrete shall be made of materials and mix proportions approved by the Technician. Concrete that will be exposed to the atmosphere when construction is completed shall contain not less than 6 sacks of cement per cubic yard of concrete. Concrete that will be permanently covered shall contain not less than 5 sacks of cement per cubic yard.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved compacted earth fill. If the backfill is to become the subgrade for riprap, rock fill, drain fill, or sand or gravel bedding, the voids may be filled with material conforming to the specifications for the riprap, rock fill, bedding, drain fill, or gravel. Before correcting an over-excavation condition, the contractor shall review the planned corrective action with the Technician and obtain approval of the corrective measures.

11. MEASUREMENT AND PAYMENT

(Used only if applicable)

For items of work for which specific unit prices are established, each item will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price for that item. For items of work for which specific lump sum prices are established, payment will be made at the lump sum price.

Measurement and payment will be made to the nearest cubic yard between the finished design surface and original topographic surface as defined in the NRCS CIVIL 3D Digital Elevation Model. All quantities in these specifications and shown on the Drawings are measured as in place, bank cubic yards.

Excavation for Bank Protection and other Subsidiary Items will not be measured or paid for separately. Compensation for these items is included in payment for the appropriate items listed in the bid schedule.

Such payment will constitute full compensation for all materials, labor, equipment, tools, and all other items

necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

Acceptable vertical tolerances shall be + 0.1 to - 0.3 feet from the lines and grades shown on the Drawings. Horizontal tolerances shall be +/- 0.5 feet for bankfull channel construction and +/- 2.0 feet for floodplain construction.

12. SPECIAL PROVISIONS

See Attached Sheet.

12. SPECIAL PROVISIONS – EXCAVATION (MT-104)

Bid Item 6, Floodplain Excavation,	67,198 c.y.
Bid Item 7, Bankfull Channel Excavation,	15,747 c.y.
Bid Item 8, Waste for Endhaul Offsite,	57,736 c.y.
Subsidiary Item, Excavation for Type I Bank Protection,	5,301 c.y.
Subsidiary Item, Excavation for Type II Bank Protection,	1,481 c.y.
Subsidiary Item, Excavation for Type III Bank Protection,	1,682 c.y.
Subsidiary Item, Excavation for Type IV Bank Protection,	159 c.y.
Subsidiary Item, Excavation for Riffle Bank Protection,	742 c.y.
Subsidiary Item, Excavation for Cobble Patch Structures,	491 c.y.
Subsidiary Item, Excavation for Breed Creek,	186 c.y.
Subsidiary Item, Excavation for Rock Plugs and Cross Vanes,	Not Quantified
Subsidiary Item, Excavation for Rock Drops,	Not Quantified

1. These items shall consist of all excavation and hauling required to construct the project to the lines and grades shown on the drawings.

2. Excavation quantities are listed in BANK CUBIC YARDS, (volume in place):

   Definitions are as follows:

   a. Floodplain Excavation is the material excavated to achieve the inset floodplain and bankfull bench elevations. The specified quantity includes 12-inches of over-excavation as specified on the drawings.
   b. Bankfull Channel Excavation is the excavated material below the bankfull bench elevation required to create the bankfull channel. The specified quantity does NOT include Subsidiary Item Excavations required for Bank Protection. Compensation for Subsidiary Item Excavations shall be included in payment under the appropriate bid item.
   c. Waste for Endhaul Offsite is the excess material generated from floodplain and bankfull channel construction. The specified quantity does NOT include excess material generated from Subsidiary Item Excavations. Compensation for hauling waste from Subsidiary Item Excavations shall be included under the appropriate bid item.
   d. Excavation for Cobble Patch Structures does not include over-excavation within saturated channel bottom materials required to obtain key trench grade.
   e. Excavation for Breed Creek includes all excavation required to complete this portion of the project.
   f. Soil is the top 12 inches of the soil profile and deeper materials which are approved by the NRCS Technician as being acceptable. Soil serves as material commonly referred to as Topsoil.
   g. Coarse Grained Material shall consist of sand, gravel, and fines from the required excavations.

3. In Section 2, CLASSIFICATION, all excavation shall be classified as COMMON EXCAVATION. The presence of isolated boulders or rock fragments larger than 1 cubic yard in size, presence of large trees, frozen soil, excavation below the water surface, and saturated soils will not in themselves be sufficient to change the classification.

4. In Section 4, STRIPPING, the top 12-inches of Floodplain Excavation material shall be salvaged and stockpiled for use as Soil Fill as specified in Construction Specification, Earthfill MT-105. Additional stripping depth will be required to meet required Soil quantities for Soil Fill as well as Subsidiary Soil Items. Stockpiling materials excavated from deeper than 12-inches is acceptable to meet required earthfill quantities upon approval by the NRCS Technician.

5. In Section 6, USE OF EXCAVATED MATERIALS, Soil and Coarse Grained Materials needed for project construction, shall be stockpiled separately. Stockpiles shall be located within designated areas as shown on the Construction Work Limits (Sheet 21 of the Drawings) or pre-approved by the OWNER. Rocks and other materials greater than 6-inches in size shall be removed from all soil prior to final placement in fill sections.

6. In Section 7, DISPOSAL OF WASTE MATERIALS, the CONTRACTOR shall make the necessary arrangements to haul the Waste for Endhaul and excess Subsidiary excavated materials to an acceptable disposal site.

7. In Section 7, DISPOSAL OF WASTE MATERIALS, saturated materials excavated from the site shall be free of draining water prior to hauling off site.

8. In Section 8, EXCAVATION LIMITS, riffle section channel bottom shall be under-excavated by 0.3 feet from the grade shown on the Drawings to allow for channel armoring. Quantity computations for bankfull channel excavation account for this volume of under-excavation.

9. In Section 10, OVER-EXCAVATION, provided that bank protection prescriptions (Sheets 12 – 16 in the drawings) are installed promptly after construction of the channel bank, the CONTRACTOR shall NOT be required to rework channel bed and banks (due to sloughing and/or deposition) after construction inspection has shown that finished surface DEM coordinates and elevations were attained.

10. In Section 10, OVER-EXCAVATION, the floodplain shall be over-excavated by 12 inches except in isolated areas designated as SHALLOW CUT AREAS on the drawings. Boundaries identifying SHALLOW CUT AREAS will be staked by NRCS. Over-excavated volumes of material will be replaced with Soil Fill according to Construction Specification, Earthfill MT-105.

11. In Section 11, MEASUREMENT AND PAYMENT, bankfull channel excavation within riffle sections shall meet the vertical tolerances specified. Tolerances shall be measured relative to the 0.3 feet under-excavated elevation as described in Item #9 of these Special Provisions.

Earth Fill

1. SCOPE

The work shall consist of construction of earth embankments, other earth fill as required by the drawings and specifications.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Technician.

Fill materials shall contain no frozen soil, sod, brush, roots or other perishable materials. Unless otherwise specified, rock fragments incorporated in the fill shall be no larger than one-half of the lift thickness specified for each type of fill. Over-sized material shall be removed prior to compaction.

The types of materials used in the various fills shall be as listed and described in the special provisions and drawings.

3. FOUNDATION PREPARATION

Foundations for earth fill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earth fill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earth fill as specified for subsequent layers of earth fill.

Earth abutment surfaces shall be free of loose, un-compacted earth in excess of 2 inches in depth normal to the slope and shall be at such a moisture content that the earth fill can be compacted against them to produce a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose materials by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earth fill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be no steeper than one horizontal to one vertical (1:1) unless otherwise specified. Test pits or other cavities shall be filled with compacted earth fill conforming to the specifications for the earth fill to be placed upon the foundation.

4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Technician. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed the maximum thickness specified, or 8 inches if not specified. Materials placed by dumping in piles or windrows shall be spread

uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of fill compacted by manually directed power tampers, or 6 inches if not specified.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earth fill in dams, levees and other structures designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material. Zone earth fills shall be constructed concurrently unless otherwise specified.

b. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

c. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of approximately two percent shall be maintained to insure effective drainage, and except as otherwise specified for drain fill or sectional zones.

d. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are specifically authorized.

e. Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in-place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical (3:1). The bonding surface of the embankment in-place shall be stripped of all material not meeting the requirements of this specification. The bonding surface shall be scarified, moistened and re-compacted when the new fill is placed against it to ensure a good bond with the new fill and to obtain the specified moisture content and density at the contact of the in-place and new fills.

5. CONTROL OF MOISTURE CONTENT

Unless otherwise specified, the moisture content of the fill material shall be maintained within the range required to permit maximum compaction. The moisture content in plastic clays and silts should be such that when kneaded in the hand it will form a ball which does not readily separate when struck sharply with a pencil or which refuses to separate when pressed between the hands.

When working with sandy materials, the moisture content should be such that the material tends to form a ball under pressure, but seldom holds together.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement

on the fill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet (yields free water when kneaded in the hand) when deposited on the fill shall either be removed or be dried to the proper moisture content prior to compaction.

If the top surface of the preceding layer of compacted fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

6. COMPACTION

Unless otherwise specified, earth fill shall be compacted by one or a combination of the following methods:

A. Controlled movement of the hauling and spreading equipment over the area so that the entire surface area of each lift will be traversed by not less than 1 tread track of the loaded earth-moving equipment traveling in a direction parallel to the axis of the fill.

B. Each lift shall be compacted by not less than two complete passes of padfoot/tamping foot style roller (roller modified with trapezoidal pads attached to a drum) exerting a minimum pressure of 100 pounds per square inch.

The completed fill shall be constructed to the lines and grades shown on the plans or as staked by the Technician, plus the allowance indicated for settlement.

7. COMPACTION ADJACENT TO STRUCTURES

Unless otherwise specified, fill adjacent to structures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually directed power tampers, plate vibrators, or walk-behind, miniature, or self-propelled rollers.

Heavy equipment including backhoe-mounted power tampers, or vibrating compactors and manually-directed vibrating rollers, shall not be operated within 3 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

The passage of heavy equipment will not be allowed: (1) over cast-in-place conduits prior to l4 days after placement of the concrete; (2) over cradled or bedded precast conduits prior to 7 days after placement of the concrete cradle or bedding; or (3) over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 3 feet, whichever is greater.

8. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE FILL

Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

9. MEASUREMENT AND PAYMENT
(Used only if applicable)

For items of work for which specific unit prices are established, each item will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price for that item. For items of work for which specific lump sum prices are established, payment will be made at the lump sum price.

Measurement and payment will be made to the nearest cubic yard between the finished design surface and original topographic surface as defined in the NRCS provided CIVIL 3D Digital Elevation Model. All quantities in these specifications and shown on the Drawings are measured as in place, bank cubic yards.

Earthfill for Bank Protection and other Subsidiary Items will not be measured or paid for separately. Compensation for these items is included in payment for the appropriate items listed in the bid schedule.

Such payment will constitute full compensation for all materials, labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

Acceptable vertical tolerances shall be + 0.1 to – 0.3 feet from the lines and grades shown on the Drawings. Horizontal tolerances shall be +/- 0.5 feet for bankfull channel construction and +/- 2.0 feet for floodplain construction.

10. SPECIAL PROVISIONS

See Attached Sheet.

10. SPECIAL PROVISIONS – EARTHFILL (MT-105)

Bid Item 9, Soil Fill,	16,134 c.y.
Bid Item 10, Old Channel Fill,	9,075 c.y.
Subsidiary Item, Soil for Type I Bank Protection,	527 c.y.
Subsidiary Item, Coarse Grained Material for Type I Bank Protection,	4,303 c.y.
Subsidiary Item, Coarse Grained Material for Type II Bank Protection,	91 c.y.
Subsidiary Item, Soil for Type II Bank Protection,	474 c.y.
Subsidiary Item, Soil for Type III Bank Protection,	736 c.y.
Subsidiary Item, Soil for Type IV Bank Protection,	58 c.y.
Subsidiary Item, Soil for Riffle Bank Protection,	742 c.y.
Subsidiary Item, Soil for Breed Creek,	43 c.y.

1. These items shall consist of all earthfill required to construct the project to the lines and grades shown on the drawings.

2. Definitions are as follows:

    a. Soil Fill is the material placed to generate a topsoil layer within the inset floodplain, bankful bench, overflow channel areas, and low area on Adam's property. This material was stripped from the top 12-inches of Floodplain Excavation and stockpiled for later use. The specified Soil Fill quantity does NOT include Subsidiary Item Soil quantities.
    b. Old Channel Fill is Coarse Grained Material utilized to fill for the overflow channel and abandoned portions of the existing Big Spring Creek channel. The specified quantity does NOT include Subsidiary Item Coarse Grained Material quantities.

3. In Section 2, MATERIALS, sod and roots are acceptable in the Soil Fill and Subsidiary Soil Items.

4. In Section 4, PLACEMENT, fill around logs and rootwads shall be placed equally on each side to prevent displacement and placed carefully to prevent damage.

5. In Section 4, PLACEMENT, all fill material below base flow water surface elevations shall be Coarse Grained Material unless otherwise specified. To the fullest extent practical, the coarsest materials shall be placed around rock and log structures.

6. In Section 4, PLACEMENT, Soil shall be used for fill material above base flow water surface elevations as shown on the drawings. Lift thickness shall be 6-inches for bank treatments (Type I, II, III, IV, and Riffle).

7. In Section 4, PLACEMENT, Old Channel Fill required to construct riffle channel bottom surfaces shall be placed to elevations 0.3 feet greater than shown on the drawings to allow for channel armoring.

8. In Section 4, PLACEMENT, Coarse Grained Material shall be mixed and/or washed into the woody slash and branch material of Type II Bank Protection in order to adequately fill voids.

9. In section 6, COMPACTION, Coarse Grained Material placed in water will require no additional compactive effort beyond that associated with placement operations. When

placed above the water level, it shall be compacted with the excavator bucket or in accordance with Section 6A or 7.

10. In Section 6, COMPACTION, Soil placed on the floodplain shall be compacted by Method A. The top 4 inches of surfaces to be seeded shall not be compacted other than that required to smooth and shape the area.

11. In Section 6, COMPACTION, Soil placed within Type I, II, III, and IV Bank Protection and Riffle Bank Protection, shall be compacted with the excavator bucket or in accordance with Section 7.

12. In Section 6, COMPACTION, woody slash and branch material along with the void filling Coarse Grained Material shall be pressed into place with the back of the excavator bucket in order to assure a dense compact section.

Rock Riprap

1. SCOPE

The work shall consist of the construction of loose rock riprap revetments and blankets, including filter layers or bedding where specified.

2. MATERIALS

Rock

Rock for rock riprap shall be obtained from the designated sources or, if the source is not specified, shall conform to the following specifications:

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to sub-rounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Unless otherwise specified and except as provided below, the rock shall have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 + 300 grams of rock fragments, reasonably uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

Rock that fails to meet the requirements stated in a, b, and c above, may be accepted only if similar rock from the same source has been demonstrated to be sound after five years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

Filter and bedding materials

When required, **granular** filter and bedding materials shall, unless otherwise specified, conform to Montana Construction Specification MT-117, Drainfill and Filters.

3. GRADING

The rock shall conform to the specified grading limits after it has been placed in the riprap.

The rock shall be free from dirt, clay, sand, rock fines and other materials not meeting the required gradation limits.

At least 30 days prior to delivery of rock from other than designated sources, the Contractor shall designate in writing the source from which they intend to obtain the

rock. The Contractor will also provide satisfactory documentation to the Technician that the material meets the requirements of the specifications. The Contractor shall provide the Technician free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in the special provisions.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in the special provisions. The rock shall conform to the specified grading limits when installed in the riprap.

4. SUBGRADE PREPARATION

The subgrade surfaces on which the riprap or bedding course is to be placed shall be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap shall not be placed until the foundation preparation is completed and the subgrade surfaces have been inspected and approved by the Technician.

5. EQUIPMENT-PLACED ROCK RIPRAP

The rock shall be placed by equipment on the surfaces and to the depths specified. The riprap shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The rock shall be delivered and placed in a manner that will insure that the riprap in place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks.

Riprap shall be placed in a manner to prevent damage to structures. Hand placing will be required to the extent necessary to prevent damage to the permanent works.

6. HAND-PLACED RIPRAP

The rock shall be placed by hand on the surfaces and to the depths specified. It shall be securely bedded with the larger rocks firmly in contact one to another. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on edge.

7. FILTER LAYERS OR BEDDING

When filter layers or bedding beneath riprap is specified, the filter or bedding material shall be spread uniformly on the prepared subgrade surfaces to the depth specified. Compaction of filter layers or bedding will not be required, but the surface of such layers shall be finished reasonably free of mounds, dips or windrows.

When a geotextile filter is specified, the material used shall be non-woven and meet the requirements as outlined in Table 1. Geotextile shall be joined by over-lapping a minimum distance of 18 inches. Anchoring of the fabric is not required but care shall be taken to minimize displacement.

Rock riprap shall not be dropped from a height greater than three feet on geotextile. Sufficient hand work shall be done to produce a dense section with a neat and uniform surface.

8. MEASUREMENT AND PAYMENT
(Used only if applicable)

Items of work for which specific unit prices are established, will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price

for that item. Items of work for which specific lump sum prices are established; payment will be made at the lump sum price.

Measurement and payment will be made to the nearest cubic yard and will be based on the neat lines shown on the drawings.

Such payment will constitute full compensation for all materials, labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for geotextile or any other item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

TABLE 1. REQUIREMENTS FOR NONWOVEN GEOTEXTILES

PROPERTY	TEST METHOD	Class I	Class II
Weight - Typical	ASTM D-5261	8.0 oz/sy	10 oz/sy
Tensile Strength	ASTM D-4632	205 lbs	230 lbs
Elongation @ Break	ASTM D-4632	50%	50%
Mullen Burst*	ASTM D-3786*	350 psi	500 psi
Puncture Strength*	ASTM D-4833*	110 lbs	120 lbs
CBR Puncture	ASTM D-6241	500 lbs	700 lbs
Trapezoidal Tear	ASTM D-4533	80 lbs	95 lbs
Apparent Opening Size	ASTM D-4751	80 US Sieve	100 US Sieve
Permittivity	ASTM D-4491	1.35 Sec-1	1.2 Sec-1
Water Flow Rate	ASTM D-4491	90 g/min/sf	80 g/min/sf
UV Resistance @ 500 Hours	ASTM D-4355	70%	70%

* Historical averages (current values not available): Mullen Burst Strength ASTM D-3786 is no longer recognized by ASTM D-35 on Geo-synthetics as an acceptable test method. Puncture Strength ASTM D-4833 is not recognized by AASHTO M288 and has been replaced with CBR Puncture ASTM D-6241.

Use Class I for d50 $\leq$ 15”
Use Class II for d50 $\geq$ 16”

9. SPECIAL PROVISIONS

See Attached Sheet.

10. SUBMITTALS REQUIRED

- Geotextile
- The contractor shall designate in writing the source from which they intend to obtain the rock.
- When other than pre-approved rock sources are selected for use, site specific test results shall be submitted demonstrating compliance with Section 2 of this specification.

Submittals are to be received by the Contracting Officer a minimum of 15 days prior to the start of placing rock material.

9. SPECIAL PROVISIONS – ROCK RIPRAP (MT-107)

Bid Item 11, Cross Vane Boulder Structures,	2 each
Bid Item 12, Cobble Patch Structures,	491 c.y.
Bid Item 13, Old Channel Plugs and Drop Structures,	846 c.y.
Bid Item 14, Rock for Bank Protection (Types I, II, III, IV and Breed Ck)	2387 c.y.
Bid Item 15, Rock for Breed Creek Drop Structure	122 c.y.
Bid Item 16, Boulders for Type I Bank Protection,	91 each

1. These items shall consist of furnishing and installing rock riprap, geotextile, and boulders required to construct the project to the lines and grades shown on the drawings.

2. All reference to rock riprap in this specification applies to the rock placements shown in the drawings.

3. In Section 7, FILTER LAYERS, Geotextile shall be Class I in accordance with Table 1. Quantities are as follows:

Item	Quantity	Unit
Old Channel Drop Structures	824	s.y.
Breed Creek Drop Structure	264	s.y.

4. In Section 2, MATERIALS, Boulders for Type I Bank Protection, shall have a minimum weight of 2700 pounds and volume approximating that of a 3-foot diameter, round rock.

5. In Section 2, MATERIALS, Boulders for the Cross Vane Structures shall be blocky in structure and have dimensions approaching 5’ x 3’ x 3’. The rock shall be dense, sound, and free from cracks, seams, or other defects conducive to accelerated weathering. The least dimension of an individual rock shall not be less than one-half the greatest dimension.

6. In Section 2, MATERIALS, the CONTRACTOR shall be responsible for determining the source and making arrangements to obtain the materials needed to complete this work. Potential material sources are available from Clint Smith (406-538-4658) of the Lewistown MT FWP Office upon request.

7. In Section 2, MATERIALS, Rock in the bank key portion and filler material for instream portions of the Cross Vane Boulder Structures shall meet the gradation for Old Channel Plugs and Drop Structures.

8. In Section 3, GRADING, the following gradations shall apply:

   Breed Creek Drop Structure:

Size	% Passing
24 inch	100
18 inch	60 - 100
12 inch	35 - 50
6 inch	10 - 35
3 inch	0 - 25

Old Channel Plugs and Drop Structures:

Size	% Passing
18 inch	100
13.5 inch	60 - 100
9 inch	35 - 50
4.5 inch	10 - 35
2.25 inch	0 - 25

Cobble Patch Structures:

Size	% Passing
12 inch	100
9 inch	60 - 100
6 inch	35 - 50
3 inch	10 - 35
1.5 inch	0 - 25

Type I, II, III, and IV Bank Protection and Breed Creek Bank Protection:

Size	% Passing
9 inch	100
6.75 inch	60 - 100
4.5 inch	35 - 50
2.25 inch	10 - 35
1.25 inch	0 - 25

9. In Section 3, GRADING, test piles, of sufficient size, shall be constructed on site or at the pit for each gradation. Review and approval of gradation shall be made by the Technician prior to the hauling of rock quantities. Test piles shall be prepared at least 15 days prior to construction utilizing rock gradation being approved.

OPEN CHANNEL (CODE 582)

(For Practice Standards 326, 395, 580, 582, 584)

1. SCOPE

Work shall consist of furnishing all equipment, materials, labor and performing all operations in connection with construction of the stream restoration as shown on the drawings or as specified.

The following requirements shall pertain, unless otherwise indicated in the special provisions or indicated on the construction drawings.

2. MATERIALS

Construction materials shall conform to the requirements shown on the drawings, or as specified.

Trees for Root Wads

Trees for root wads shall be sufficiently sound to permit installation and backfill without crushing, splitting, or breaking the bole of the tree. The trees shall retain at least 75 percent of the pre-harvest root fan mass and diameter after placement. Multiple trees may be bundled to form the root fan or bole diameter. The bole diameter or diameter breast height (dbh) of bundled trees shall not be less than one-third the diameter of that specified for a single tree or 8 inches in diameter, whichever is greater. The fan diameter of each bundled tree shall not be less than two-thirds of that specified for a single tree. The bole length of single trees and bundled trees shall be the same.

Trees for Footer Logs and Deflector Logs

Trees for footer logs and deflector logs shall be sufficiently sound to permit installation and backfill without crushing, splitting, or breaking the bole of the tree. Limbs do not need to remain attached to the log. The trees should be harvested with the root fan attached.

Trees for Tree Revetments and Woody Debris Structures

Trees for tree revetments shall be freshly harvested Douglas fir or juniper, unless otherwise specified. The limbs shall be “green” and pliable at the time of placement to prevent breakage. The trees shall retain limbs, needles, or leaves immediately before placement to form a single tree canopy of not less than 75 percent of the un-harvested tree.

The trees should be harvested to retain the root fan.

Tree and Shrub Transplants

Requirements for stream channel vegetation shall be in conformance with Field Office Technical Guide (FOTG), Section IV, specification for practice Critical Area Planting (Code 342) and the following provisions:

Transplants shall be selected and placed as indicated on the drawings. The transplants shall originate from a hydrologic and climatic regime similar to that of the planting site to ensure plant suitability and viability.

Transplants for clump plantings shall be harvested in such a manner that most of the root structure and associated soil is retained as a unit (clump). The clump shall be transported and planted directly into a site prepared for the clump planting. Repetitive handling, loading, unloading, and transport of the clump that damages the integrity of the root-soil mass or reduces the viability of the plants shall not be permitted.

Clump plantings shall be pruned to remove 10 to 50 percent of the vegetation of each stem in lieu of thinning. The pruning operation shall ensure that the majority of the flowering parts of the clump plantings are removed.

Transplants shall be thoroughly wetted immediately after placement.

Erosion Control Fabrics

Woven erosion control fabric shall be constructed of coir (coconut) fibers and shall have a minimum weight (ASTM D3776) of 400 grams per square meter (g/m^2) for slope protection and 700 g/m^2 when used for fabric encapsulated soil. The minimum tensile strength (ASTM D6818) shall be 56 pounds per inch in the cross direction and 120 pounds per inch in the machine directions.

Non-woven erosion control blankets shall have a minimum weight (ASTM D3776) of 300 g/m^2, a minimum thickness (ASTM D1777) of 0.25 inch, and a minimum tensile strength (ASTM D4596) of 8 pounds per inch in each direction.

Drainfill and Filters

Drainfill and filter material shall conform to Montana Construction Specification MT-117, Drainfill and Filters.

Soil Anchors

The soil anchors shall have minimum pullout strength as shown on the plans. The pullout strength shall be based on soil types, anchor depths, and specific anchor. Consult manufacturer's information for proper selection of anchors. The anchor, cables, and clamps shall be made of galvanized steel.

3. EQUIPMENT

Equipment shall be of sufficient size to lift, move, and place rock and log materials of the size specified. Equipment shall be equipped with attachments (such as shovel, bucket, backhoe, bucket with thumb) appropriate to the character of the materials and the site conditions.

Equipment shall be capable of working under water as required to construct the job.

4. BORROW EXCAVATION

When the quantities of suitable materials obtained from the excavations as shown on the drawings are insufficient to construct the fills, additional materials shall be obtained from borrow areas approved by the Technician and the Owner/Operator. Abandoned borrow areas shall be smoothed, topsoiled to a 6-inch depth, shaped, and vegetated in a manner to eliminate unstable side slopes and hazardous or unsightly conditions.

Borrow-pit ponds constructed and reclaimed for the primary purpose of wetland wildlife habitat shall have at least 50 percent of the perimeter on a 5:1 slope or flatter, with the remaining sides close to a 3:1 slope. Wetland wildlife habitat ponds shall have water no deeper than 3.5 feet over at least 25 percent of the surface area and water at least 3 feet deep over at least 25 percent of the surface area, with the maximum depth being 8 feet.

Borrow-pit ponds constructed and reclaimed for fish habitat shall have water deeper than 3.5 feet over at least 75 percent of the area and deeper than 8 feet over at least 25 percent of the surface area. Side slopes for borrow-pit ponds for fish habitat shall be approximately 3:1.

The shoreline of borrow-pit ponds shall be dressed with topsoil and seeded or sodded from the groundwater line to the natural ground surface.

5. SODDING

Viable sod with a minimum thickness of 8 inches for sedge species and 6 inches for grass species shall be placed where indicated on the drawings. Sod shall originate from a similar hydrologic and climatic regime as the zone being sodded to ensure plant species suitability and viability.

The sod shall be set firmly in place to ensure complete contact with the base material. Frozen sod shall not be placed, nor shall sod be placed on frozen ground unless the ground surface is smooth and enables firm sod to ground surface contact. Sod shall be placed to cover the entire required surface without voids or loose and protruding edges that would likely be dislodged by flowing water. Any loose sod shall be pinned or staked to the base materials with wooden stakes (1" x 2" x 16") or other approved methods.

Immediately after placement the sod shall be thoroughly wetted.

6. FABRIC ENCAPSULATED SOIL

General

Fabric encapsulated soil shall be constructed in accordance with the lines, grades, dimensions, and extent indicated on the drawings.

Surface Preparation

The surfaces on which the erosion control fabric is to be placed shall be reasonably smooth and free of loose rock, clods, holes, projections, depressions, and muddy conditions. The surfaces will be subject to approval prior to placement of fabric or soil upon the fabric.

Placement

The fabric shall be unrolled along the placement area and loosely laid, without stretching, in such a manner that it will conform to surface irregularities. Fabric placed on deformable banks shall be laid with a slack of approximately 5 percent to permit movement without damage to the fabric

The fabric shall be joined by overlapping a minimum of 18 inches and secured to the underlying foundation material. Unless otherwise shown on the plans, stapling patterns recommended by the manufacturer shall be used. All overlaps shall be in the direction of flow.

Damaged fabric shall be repaired by a patch of like fabric that extends a minimum of 2 feet from the edge of any damaged area.

Fill Materials

Fill materials in fabric encapsulated soil shall be earthfill from the required excavations and approved borrow sources. That portion of each lift that will be exposed and vegetated shall be filled with organic silts and clays to enhance vegetative establishment.

Compaction

Each lift shall be compacted prior to placement of the fabric by a minimum of 2 passes over the entire surface with wheeled excavation equipment or manually directed power tampers, or other approved method.

Compaction shall be halted if damage to underlying fabrics is observed. No compaction is required for granular fill (clean sands, gravel, and cobble).

Shaping and grading of the fabric edges may be required following compaction of fill and prior to placement of additional lifts of the fabric.

Control of Moisture Content

Earthfill shall have sufficient moisture prior to compaction that the material tends to form a ball under pressure in one's hand.

Vegetation

Fabric encapsulated soil shall be vegetated in conformance with Montana Specification/Job Sheet Critical Area Planting (Code MT342-JS1-B).

7. STREAMBANK PROTECTION USING EROSION CONTROL FABRIC AND BLANKETS

General

Erosion control fabric and blankets shall be placed to the lines and grades indicated on the drawings.

Surface Preparation

The surfaces on which the erosion control fabric and blankets are to be placed shall be smooth and free of loose rock, clods, holes, projections, depressions, and muddy conditions. The surfaces will be subject to approval prior to placement of fabric or soil upon the fabric.

Placement

The fabric shall be unrolled laterally across the slope along the placement area and loosely laid, without stretching, in such a manner that it will conform to surface irregularities.

The fabric shall be joined by lap splicing a minimum of 18 inches on the sides and 36 inches on the ends of each blanket. Both edges of the 18-inch overlap shall be staked securely. The upper and lower ends of each installation shall be buried in a 12-inch deep trench. Unless

otherwise shown on the plans, stapling patterns recommended by the manufacturer shall be used. All overlaps shall be in the direction of flow.

Damaged fabric shall be repaired by a patch of like fabric that extends a minimum of 2 feet from the edge of any damaged area.

Vegetation

Streambank slopes shall be vegetated in conformance with Montana Specification/Job Sheet Critical Area Planting (Code MT342-JS1-B).

8. SAFETY

All work shall be in accordance with safety requirements of Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Safety and Health Regulations for Construction, Subpart P, Excavations.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established, each item will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price for that item. For items of work, for which specific lump sum prices are established, payment will be made at the lump sum price.

Quantities for the individual components of all bid items under this specification will not be measured. Payment will be made to the nearest foot of bank treatment installed. Measurement will be made along the top of the bank slope. Payment on a per foot basis will include compensation for

- Excavation
- Logs and Rootwads
- Woody Materials
- Earthfill
- Willow Cuttings and Clump Plantings

Such payment will constitute full compensation for all materials, labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions, but not listed on the bid schedule, will be considered incidental to and included in the pay items listed on the bid schedule.

10. SPECIAL PROVISIONS

See Attached Sheet.

11. SUBMITTALS REQUIRED

- Erosion Control Fabric Specifications and sample

Submittals are to be received by the Contracting Officer a minimum of 15 days prior to placement of the material.

10. SPECIAL PROVISIONS – OPEN CHANNEL (MT-582)

Bid Item 17, Type I Bank Protection,	1,139 l.f.
Bid Item 18, Type II Bank Protection,	925 l.f.
Bid Item 19, Type III Bank Protection,	924 l.f.
Bid Item 20, Type IV Bank Protection,	126 l.f.
Bid Item 21, Riffle Bank Protection,	1,617 l.f.
Bid Item 22, Breed Creek,	1 each
Bid Item 23, Woven Erosion Control Fabric (Belton 900 or equal),	7,968 sq.yd.
Bid Item 24, Nonwoven Erosion Control Fabric (C125BN or equal),	5,532 sq.yd

1. These items shall include all work unless otherwise specified, materials listed below, and all other incidental materials required to construct the bank protection and Breed Creek to the lines and grades shown on the drawings.
2. Compensation for Rock (and Geotextile), and Seeding required to construct bank protection and Breed Creek shall be made under Bid Items 14, 15, and 25.
3. Estimated quantities associated with this work are as follows:

Type I Bank Protection:

Trees with Rootwads (18-30 inch DBH)	91	each
Header and Footer Logs (18-inch +/- 6-inch)	1,811	l.f.
Willow Clump Plantings (8-15 feet tall)	91	each
Excavation	5,301	c.y.
Soil for bank construction	527	c.y.
Coarse Grained Material	4,303	c.y.

Type II Bank Protection:

Woody Slash and Branch Material	304	c.y.
Coarse Grained Material within slash	91	c.y.
Soil for bank construction	474	c.y.
Excavation	1,481	c.y.

Type III Bank Protection:

Willow Cuttings (3/4 to 1-inch dia)	9,316	each
Soil for bank construction	736	c.y.
Excavation	1,682	c.y.

Type IV Bank Protection:

Soil for bank construction	58	c.y.
Excavation	159	c.y.

Riffle Bank Protection:

Soil for bank construction	742	c.y.
Excavation	742	c.y.

Breed Creek:

Willows for Brush Mattress	1,620	each
Excavation	186	c.y.
Soil	43	c.y.

4. In Section 2, MATERIALS, the CONTRACTOR shall be responsible for determining the source and making arrangements to obtain the materials needed to complete this work. Potential material sources are available from Clint Smith (406-538-4658) of the Lewistown MT FWP Office upon request.

5. In Section 2, MATERIALS, trees for Type I Bank Protection shall be Douglas Fir or Ponderosa Pine in sound condition without substantial defects.

6. In Section 2, MATERIALS, trees for Type I Bank Protection root wads shall have a bole diameter, at breast height (4.5 feet above ground level), between 18 to 30 inches. Rootwads intended for use as a root fan shall be at least 4 feet in diameter. The NRCS TECHNICIAN shall pre-approve trees at the source site prior to the commencement of hauling.

7. In Section 2, MATERIALS, trees for footer and header logs required for Type I Bank Protection shall be 18 inches in diameter +/- 6 inches throughout their length.

8. In Section 2, MATERIALS, bundled trees shall not be allowed for Type I Bank Protection unless first reviewed and approved by the NRCS TECHNICIAN.

9. In Section 2, MATERIALS, Golden Willow, Cottonwood, Willow shrubs, and coniferous tree branches are all acceptable materials for Type II Bank Protection Woody Slash and Branch materials.

   Woody Slash and Branch Gradation:

Size	% Smaller Diameter
8 inch	90
6 inch	50
4 inch	20
2 inch	< 10

10. In Section 3, MATERIALS, test pile of woody slash and sand/gravel/rock mix, of sufficient size, shall be constructed on site for gradation. Review and approval of gradation shall be made by the Technician prior to placement of the woody material.

11. In Section 2, MATERIALS, the CONTRACTOR will be required to harvest, transport, and plant willow clumps. Willow clumps shall be 8 to 15 feet in height and approximate the width of the backhoe bucket in diameter. Follow guidance in Technical Note Plant Materials 42 titled Willow Clump Plantings to complete harvest, transport, and planting work.

12. In Section 2, MATERIALS, the CONTRACTOR will be required to harvest, transport, and transplant willow cuttings. Unless as otherwise specified in the drawings or these specifications, follow guidance in Technical Note MT-25, Items D, E, F, H, I, J, and K for harvesting, storing, and planting willow cuttings. Harvesting and transplanting shall occur during the dormant season which is October 15 through April 15. Cuttings stored for less than 2 weeks may forego Item J, Pre-plant Treatment.

13. In Section 2, MATERIALS, Erosion Control Fabrics, Woven erosion control fabric shall meet or exceed specifications for Belton Geocoir 900. Non-woven erosion control fabric shall meet or exceed specifications for Tensar North American Green C125BN.

14. In Section 3, EQUIPMENT, this job will require lifting, moving, and placing 18 to 30-inch diameter tree boles with rootwads. The tree bole will be up to 25 feet long. Depending on site conditions and methods of construction, tree boles, header, and footer logs, may need to be pinned together prior to placement thus requiring movement of several log components together.

15. In Section 3, EQUIPMENT, this job will require lifting, moving, and placing 3+ foot diameter rocks. Rocks shall meet a minimum specified weight of 2700 pounds in order to be acceptable for placement in Type I Bank Protection.

16. In Section 6, FABRIC ENCAPSULATED SOIL, Fill Materials, stockpiled Soil materials shall be used to fill the soil lifts wrapped in erosion control fabric.

17. In Section 8, STREAMBANK PROTECTION USING EROSION CONTROL FABRIC AND BLANKETS, erosion control fabric shall be installed, at a minimum, according to this specification. If manufacturer's recommendations are more stringent, the manufacturer's recommendations shall be followed.

Broadcast Seeding Plan
Job Sheet MT342-JS1-B

MT342-JS1-B

Montana

Natural Resources Conservation Service — **March 2016**

Cooperator:	Big Spring Creek Group in assoc with MFWP	**MLRA:**		**Soil/Eco Site:**	Sandy Loam
Field Office:	Lewistown Field Office	**PPT:**	16-22	**Slope:**	less than 2%
Purpose	Big Spring Creek Restoration Project	**Aspect:**		**Field No.:**	FWP Easement

(1) Mechanical Seedbed Prep. (describe tillage implements and dates of operations). Producer should notify NRCS of dates of operations.

The seedbed shall be prepared by hand by scarifying to provide a roughened surface so the broadcast seed will stay in place. Rocks greater than 4-inch size shall be removed from the surface prior to seeding. Seeding shall be performed immediately after preparation of the seedbed. The seed shall be broadcast with approved types of equipment that will insure uniform distribution of the seed. The rate and amount of seed shall be as specified below. Seed shall be planted at a depth of not more than 1/4 to 1/2 inch. Immediately after the seed has been sown, the entire area shall be raked to cover the seed and walked to improve seed to soil contact.

(2) Chemical Seedbed Preparation (describe chemical, application rates and dates). Producer should notify NRCS of dates of operations.

(3)Seeding Operation (describe) — **Acres to be seeded:** 2.3

Drill (type) or Broadcast:	Broadcast	**Row Width:**	N/A	**Seed Depth:**	1/2 inch
Fertilizer (rates/kind):	None				
Irrigation (rates/kind):	None				
Planned Seeding Date:	After Construction, after October 15th and prior to May 15th				

Broadcast Seeding shall be utsed under all erosion control fabric and within 10 feet of the top of channel bank. Riparian Area Seed Mix is to be used for areas within the Riparian Area Boundary as shown on Figure 1 of these specifications.

(4) Management Recommendations and Establishment Protection (describe):

No livestock grazing during the establishment year.

Riparian Area Seeding Rates - SEED WILL BE PROVIDED BY MT FWP

Species	Release	Full PLS Rate Lbs/Ac	% of Mix Planned	Planned PLS Rate/Ac	Planned Acres	Total Lbs PLS Needed
Rosana Western Wheatgrass	4x10 lbs/ac = 40 lbs/ac	40	35%	14.00	2.3	32.20
Critana Thickspike Wheatgrass	4x7 lbs/ac = 28 lbs/ac	28	30%	8.40	2.3	19.32
Pryor Slender Wheatgrass	4x7 lbs/ac = 28 lbs/ac	28	5%	1.40	2.3	3.22
Trailhead Basin Wildrye	4x7 lbs/ac = 28 lbs/ac	28	25%	7.00	2.3	16.10
Stillwater Prairie Coneflower	4x 2 lbs/ac = 8 lbs/ac	8	5%	0.40	2.3	0.92
		Total	100%			

Conservation Planner: _____ Date: _____

I have reviewed and understand the requirements of the seeding plan provided and agree to implement the practice as designed. Any changes to seeding plan due to cost or availability of planned species must be approved by NRCS prior to seed purchase.

Cooperator: _____ Date: _____

Permission given to use by Idaho NRCS

10. SPECIAL PROVISIONS – BROADCAST SEEDING PLAN (MT342-JS1-B)

Bid Item 25, Broadcast Seeding 2.3 acres

1. This item shall consist of preparing the seedbed, broadcasting (with seed provided), and packing all disturbed areas where seeding with drills is not feasible.
2. Broadcast Seeding shall be utilized under all erosion control fabric and within 10 feet of the top of channel bank.
3. Seed quantities will be provided by MT Fish Wildlife and Parks.
4. The Riparian Area Seed mix shall be utilized on all broadcast seeded areas between the stream channel and the Riparian Area Boundary as shown on Figure 1 of these specifications.
5. Seeding shall be done as soon as possible after construction is completed but not before October 15th and not after May 15th.
6. Payment for this item shall be made at the contract unit price per acre. GPS aerial measurement shall be made by NRCS to the nearest 0.1 acre. Payment shall constitute full compensation for all materials, labor, equipment, tools, and other items necessary and incidental to the completion of the work.

Drill Seeding Plan
Job Sheet MT342-JS1-D

MT342-JS1-D

Montana

Natural Resources Conservation Service — **March 2016**

Cooperator:	Big Spring Creek Group in assoc with MFWP	**MLRA:**		**Soil/Eco Site:**	Sandy Loam
Field Office:	Lewistown Field Office	**PPT:**	16-22	**Slope:**	less than 2%
Purpose	Big Spring Creek Restoration Project	**Aspect:**		**Field No.:**	FWP Easement

(1) Mechanical Seedbed Prep. (describe tillage implements and dates of operations). Producer should notify NRCS of dates of operations.

The seedbed shall be adequately loosened (4-6 inches deep) and smoothed. Disking or cultipacking or both may be necessary. The resulting seedbed shall be clean, firm, and weed-free. Seedbed preparation for roads built as a result of this project shall also incorporate ripping and topsoiling. Rocks greater than 4-inch size shall be removed from the surface prior to seeding. Seeding shall be performed immediately after preparation of the seedbed. The seed shall be drilled with approved types of equipment that will insure uniform distribution of the seed. Seed shall be planted at a depth of not more than 1/4 to 1/2 inch. Immediately after the seed has been sown, the entire area shall be cultipacked to cover the seed and improve seed to soil contact.

(2) Chemical Seedbed Preparation (describe chemical, application rates and dates). Producer should notify NRCS of dates of operations.

(3)Seeding Operation (describe)

Riparian Area Acres: 11.8
Hayland Area Acres: 11.7

Drill (type) or Broadcast:	Drilled	**Row Width:**	≤ 14 inches	**Seed Depth:**	1/2 inch
Fertilizer (rates/kind):	None				
Irrigation (rates/kind):	None				
Planned Seeding Date:	After Construction, after October 15th and prior to May 15th				

Riparian Area Seed Mix is to be used for areas within the Riparian Area Boundary as shown on Figure 1 of these specifications. The Hayland Area Seed Mix is to be used for areas outside the Riparian Area Boundary.

(4) Management Recommendations and Establishment Protection (describe):

No livestock grazing during the establishment year.

Riparian Area Seeding Rates - SEED WILL BE PROVIDED BY MT FWP

Species	Release	Full PLS Rate Lbs/Ac	% of Mix Planned	Planned PLS Rate/Ac	Planned Acres	Total Lbs PLS Needed
Rosana Western Wheatgrass	4x10 lbs/ac = 40 lbs/ac	40	35%	14.00	11.8	165.20
Critana Thickspike Wheatgrass	4x7 lbs/ac = 28 lbs/ac	28	30%	8.40	11.8	99.12
Pryor Slender Wheatgrass	4x7 lbs/ac = 28 lbs/ac	28	5%	1.40	11.8	16.52
Trailhead Basin Wildrye	4x7 lbs/ac = 28 lbs/ac	28	25%	7.00	11.8	82.60
Stillwater Prairie Coneflower	4x 2 lbs/ac = 8 lbs/ac	8	5%	0.40	11.8	4.72
	Total	100%				

Hayland Area Seeding Rates - SEED WILL BE PROVIDED BY MT FWP

Species	Release	Full PLS Rate Lbs/Ac	% of Mix Planned	Planned PLS Rate/Ac	Planned Acres	Total Lbs PLS Needed
Rosana Western Wheatgrass	2x10 lbs/ac = 20 lbs/ac	20	30%	6.00	11.7	70.20
Critana Thickspike Wheatgrass	2x7 lbs/ac = 14 lbs/ac	14	15%	2.10	11.7	24.57
Pryor Slender Wheatgrass	2x7 lbs/ac = 14 lbs/ac	14	10%	1.40	11.7	16.38

Luna Pubescent Wheatgrass	2x10 lbs/ac = 20 lbs/ac	20	35%	7.00	11.7	81.90
Alafalfa	2x 5 lbs/ac = 10 lbs/ac	10	10%	1.00	11.7	11.70
		Total	100%			

Conservation Planner: _____ Date: _____

I have reviewed and understand the requirements of the seeding plan provided and agree to implement the practice as designed. Any changes to seeding plan due to cost or availability of planned species must be approved by NRCS prior to seed purchase.

Cooperator: _____ Date: _____

Permission given to use by Idaho NRCS

10. SPECIAL PROVISIONS – DRILL SEEDING PLAN (MT342-JS1-D)

Bid Item 26, Drill Seeding, 23.5 acres

1. This item shall consist of preparing the seedbed, drilling (with seed provided), and cultipacking all disturbed areas within the work limits as shown on Sheet 21.
2. This Drill Seeding specification shall be utilized for all disturbed areas except where Broadcast Seeding is specified (See Special Provisions – Broadcast Seeding MT342-JS1-B).
3. Estimated acres for Drill Seeding do NOT include the near bank and streambank acres specified for Broadcast Seeding.
4. Seed quantities shall be provided by MT Fish Wildlife and Parks.
5. The Riparian Area Seed mix shall be utilized on all areas between the stream channel and the Riparian Area Boundary as shown on Figure 1 of these specifications. The Hayland Area Seed mix shall be utilized on all disturbed area outside the Riparian Area Boundary.
6. Seeding shall be done as soon as possible after construction is completed but not before October 15th and not after May 15th.
7. Payment for this item shall be made at the contract unit price per acre. GPS aerial measurement shall be made by NRCS to the nearest 0.1 acre. Payment shall constitute full compensation for all materials, labor, equipment, tools, and other items necessary and incidental to the completion of the work.

Possible Staging/Stockpile Area

Approximate Riparian Area Seeding Boundary

Approximate Ownership Boundaries

Notes: Disturbed Areas outside the Riparian Area Seeding Boundary shall be seeded utilizing the Hayland Area Seeding Plan.

Riparian Area Seeding: 14.1 Ac
Hayland Area Seeding: 11.7 Ac**

Note: Seeding area is estimated based on areas delineated for staging and stockpiling.

Acres to be Broadcast: 2.3 Ac
Acres to be Drilled: 23.5 Ac

Acres to be broadcast are located under the Erosion Control Fabric and within 10 ft of the top of channel bank.

100 0 100 200
Scale in Feet

PLAN VIEW
RIPARIAN AREA SEEDING BOUNDARY

Designed K Hoffman 3/2016
Drawn K Hoffman 3/2016
Checked S Becker 3/2016
Approved

MT342—Fig. 1 RIPARIAN AREA SEEDING BDRY
BIG SPRING CREEK RESTORATION PROJECT
MACHLER, ADAMS And MT FISH WILDLIFE & PARKS
FERGUS COUNTY MONTANA

USDA United States Department of Agriculture
Natural Resources Conservation Service

File No. Riparian Area Seed Boundary.dwg
Drawing No. Figure 1
3/28/16 4:21 PM
Sheet 1 of 1

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho

TN PLANT MATERIALS NO. 42 **DECEMBER 2003**

Willow Clump Plantings

J. Chris Hoag, Wetland Plant Ecologist
Plant Materials Center, Aberdeen, Idaho

Excavator moving a harvested willow clump to planting site on Mary Jane Creek, Manitou, Manitoba, Canada in 2000.

Willow Clump Plantings

J. Chris Hoag, Wetland Plant Ecologist, Plant Materials Center, Aberdeen, Idaho

Introduction:

Willow clump plantings are a streambank soil bioengineering technique that can be used when large stands of willows are available in the project site area. This Streambank Soil Bioengineering technique harvests an entire live willow clump including the above ground stems and roots. This method unlike pole cuttings, already has part of the root system present, so the willow doesn't need to grow as many new roots from scratch. This results in a significant advantage for the plant in terms of shortened establishment period, lower failure rate and faster protection of the problem site.

Another principle that makes this technique desirable is that willows are depositional plants. Willows generally grow in riparian areas and on flood plains that commonly receive sediment from upstream sources. Some of this sediment deposits around the stems when stream flows bring high sediment laidened water that flows through the willow stems, slowing flow velocity and thus dropping sediment.

Willow stem collars (where the stem meets the root material), unlike conifers for example, do not need to be at the soil surface or slightly below the soils surface in order for the plant to survive. When sediment is dropped out of the water column, it accumulates around the stem. As the stems are covered with sediment, the root buds in the stem swell and start to sprout roots. This is one way willows increase their root mass. This also results in more stems and leaves. This ability to adapt to sediment deposition makes willow clump plantings a great Streambank Soil Bioengineering technique especially on channel reconstruction projects, for stabilizing outside meanders, areas where cuttings are difficult to plant, and where soil conditions such as saturation or very fine soils make it difficult for willow cuttings to establish new roots.

Willow clump harvesting and planting methods

- This method should only be used where willows cover extensive areas of the floodplain or meadow areas. In addition, the willow stand should show good regeneration over the area.

- Locate willow clumps that are young and vigorous, about 8-20 feet tall, and about the diameter of the backhoe bucket. Dig straight down and under to the willow clump root mass. Start the hole about 10 inches away from the stems and dig down about the depth of the bucket (approximately 2 feet). Try to get about 70% of the root mass.

- If the planting site is close to the willow clump source, dig the clump and travel to the planting site with it in the bucket. Try to keep as much soil as possible around the root mass.

- If the planting site is a long distance from the harvest site, dig as many willow clumps as you can fit on a flatbed trailer and replant within one hour. Do not allow the clumps to dry out significantly. Transport the clumps to the planting site on the trailer. If it is sunny and hot, consider temporarily tarping the clumps to reduce sun exposure and potential drying during transport. Water the willow clumps when they have arrived at the planting if it will some time before clumps can be planted. Avoid leaving the clumps for long periods in the sun.

- Dig the clumps about 15- 20 feet apart in areas that have lots of willows. Do not harvest willows from critical locations that would be prone to future erosion. The hole that the willow was removed from should be refilled with local, good quality soil materials from off-site locations. Pack the soil firmly in the excavated hole.

- Soil conditions will vary from site to site. In some situations, you will be able to plant the clumps without pre-digging the planting hole by pushing the soil out of the hole with the bottom of the backhoe bucket and then dropping the clump into this hole. Under more difficult soil conditions or where the watertable is deep, you will need to pre-dig the holes to put the willow clumps in. Dig the holes deep enough so you are just above the standing watertable. Do not dig into the watertable.

Ideally you want the root mass of the clump to be in the saturated moisture zone and not in the standing water zone. Dig a hole that is close to the diameter of the clumps. You want to have at least 4-5 feet of the willow stems sticking out of the ground when you are finished planting the clump.

- Pull the clumps off the trailer with a thumb on the backhoe or with the front-end bucket and drop them in the holes. Fill in the hole with soil and water. Muddy-in the willow clumps so there are no air pockets around the root mass.

- The last step is to take a set of loppers and cut off about one third to one half of the willow tops straight across. This decreases the amount of stem that the reduced root mass will have to support. It also stimulates a dense regrowth of stems and leaves that will speed up the photosynthesis process to grow additional roots, stems, and leaves and store energy in the root mass.

- Spacing between the willow clumps should be about 6-15 feet. This depends on the critical streamflow energy you are trying to protect against. If your harvest site does not have enough willows, change to a wider spacing. However, the wider the spacing, the more the potential stream energy can impact the bank area you are trying to protect.

This method is more successful than planting cuttings and more tolerant of droughty conditions.

You should always obtain permission to harvest clumps from the landowner or public land management agency. In addition, state and federal regulators should be consulted to obtain permits if required and to ensure that they concur with the practice.

Case Study Examples

Medicine Lodge Creek, ID

A serious bank erosion problem on the lower end of Medicine Lodge Creek about 15 miles West of Dubois, Idaho on the Jack Webster ranch was designed and treated with rock rip-rap, clumps, stream barbs, fascines, and a brush mattress by Bob Lehman, NRCS AE in 2000. This area is extremely dry and the riparian vegetation is limited to the wetted areas of the stream. The willow clump plantings established extremely well and helped to add aesthetics to the rock rip-rap as well as other functions like wildlife habitat, water quality improvement, and fish habitat.

Figure 1: Eroding bank on the Jack Webster Ranch, lower end of Medicine Lodge Creek about 15 miles West of Dubois, ID in March, 2000.

Figure 1: Willow clumps installed in rip-rap along the lower end of Medicine Lodge Creek about 15 miles West of Dubois, ID in August, 2000.

Figure 2: Willow clump planting on Medicine Lodge Creek after one growing season (August, 2001).

Irving Creek, ID

Irving Creek, a tributary of Medicine Lodge Creek about 25 miles West of Dubois, Idaho near the Montana border, had some major erosion problems because of an improperly installed culvert. The entire stream below the culvert was downcut and the willow community was dying because the watertable was well below the root mass. The steep banks were reshaped and willow clumps were placed at the toe of the bank. Large rocks were placed as toe rock in front of the clumps. The willow clumps were trimmed back so that about 1/3 of the stems remained. New growth was extensive and lush.

Figure 3: Steep cut bank on Irving Creek was being eroded away especially during high water periods. The landowner signed up for a NRCS program called Continuous CRP to restore the stream in exchange for fencing out the cows.

Figure 4: Willow clumps installed on Irving Creek, a tributary of Medicine Lodge Creek, about 25 miles West of Dubois, ID

Corral Creek, ID

Corral Creek, near Fairfield, Idaho in Camas County is a small stream that had major bank erosion. The landowner wanted to restore the willow community and protect adjacent grazing lands. A large willow community was located close to the project site and willow clumps were harvested and brought to the site where the backhoe placed the clump into the bank by pushing the soil out of the hole with the bottom of the backhoe bucket and then dropping the clump straight into the hole. Sod mats from adjacent locations were then placed above the willow clumps to the top of the bank. This was the first willow clump planting project by NRCS in the state of Idaho – installed in 1985.

Figure 5: Willow clump planting with sod mats on a streambank of Corral Creek near Fairfield, Camas County, ID

Figure 6: Corral Creek willow clump planting after a few years of growth. Note sediment deposition and grass growth between willows and stream – most of this deposition occurred the first year following planting as a result of the willow clumps, when above ground willow stems reduced the stream energy-flow rate on the outside meander resulting in sediment deposition in front of the willow clumps. This was quickly followed by natural revegetation of the sediment and permanent relocation of the low flow stream channel.

United States Department of Agriculture
NATURAL RESOURCES CONSERVATION SERVICE
Forestry Technical Note No. MT-25
April 2005

FORESTRY TECHNICAL NOTE

Improving the Establishment of Willow Cuttings in Riparian Areas

Robert Logar, State Staff Forester
Joseph Scianna, Horticulturist

Introduction: Many riparian areas can be improved by supplemental plantings that enhance stream bank stability, increase biodiversity, create wildlife habitat, and improve water quality. One method of supplemental planting is using willow cuttings along the stream bank. Adventitious rooting of willows is easy and successful when performed properly. This Technical Note describes important establishment factors and techniques when using willow cuttings in riparian plantings.

I. TECHNIQUES:

A. Planning: Determine if willows are indigenous to the site you intend to plant. Determine if the site has the hydrology, soils, frequency, and duration of flooding needed to support adventitious rooting of willows, as well as successful long-term establishment and growth of plants. Proper riparian grazing management must be in place to allow establishment and growth of cuttings. Notify the appropriate agencies and obtain any needed permits prior to starting any reshaping work.

Note: Several management factors have been determined to be critical in Montana for successful plant establishment in riparian conservation practices. Livestock exclusion until woody plants are adequately sized to tolerate browsing, trampling, and rubbing is necessary prior to riparian project initiation. Physical or electrical exclusion with fencing is necessary. Protection from wildlife including deer, moose, rabbits, mice, voles, and other rodents is also necessary. Use tree shelters, repellants, sacrifice crops, and other animal control techniques to exclude or minimize damage to woody plantings in riparian projects. Drift from non-selective and broad-leaf selective herbicides, especially when applied to adjacent pasture and rangeland from aircraft or large ground sprayers, can be detrimental to woody plant survival,

establishment, and growth. Herbicides with lengthy residual soil activity may prevent adventitious root formation or survival of transplanted nursery stock. Examine past and planned herbicide prescriptions and applications for the riparian area and adjacent land prior to project initiation. Make sure that herbicides are labeled for use near riparian areas (surface water) and are compatible with woody plants.

B. Species Selection: There are numerous willow species with varying growth habits native to Montana. Select willow species and types appropriate for the planting site. Inventory the proposed planting site, or a comparable site within close proximity, for existing woody species and growing conditions (Riparian Planting Zone, elevation, etc.). On-site observation is the best method to assist in the species selection process. When possible, plant the same species and/or type of willow in stream locations and Riparian Planting Zones in which they are normally found. Success will significantly increase when these steps are followed. Select species with a high probability of producing adventitious roots. Reference Plant Materials Technical Note No. MT-36, *Users Guide to the Description, Propagation and Establishment of Native Shrubs and Trees For Riparian Areas in the Intermountain West* and *Plants for Riparian Buffers*, USDA-NRCS Plant Materials Centers, Idaho and Montana, for species root-ability.

C. Source of Cuttings: Willow cuttings may be procured from commercial nurseries as un-rooted or rooted cuttings, or they can be obtained from native stands located near the site. When using cuttings from commercial sources, select species and stock sources compatible with the planting site. If commercial cuttings taken from local donor plants are not available, use cuttings taken from parent plants found growing under similar environmental conditions, especially in relation to elevation and USDA Winter Hardiness Zone. When local stands of appropriate species are available, collect from native stands of healthy trees in closest proximity to the planting site. Do not over harvest cuttings from native stands. Commercial cuttings generally have better vigor, are more uniform and establish more successfully than native cuttings.

D. Cutting Diameter: Inadequate cutting diameter has been identified as a contributing factor to poor adventitious root formation from cuttings. Use or harvest cuttings that are ½ to 1 inch in diameter (at least index finger diameter). Take cuttings from wood that is 3 years old or less. Wood older than 3 years has decreased adventitious rooting ability caused by decreasing pre-formed initials, decreasing adventitious buds, and increasing bark thickness. Avoid small diameter, weak cuttings with low levels of stored carbohydrates needed for adventitious root initiation and growth.

E. Cutting Length: The optimum length of willow cutting is determined by the depth to summer water table. The cuttings must extend several inches into the summer water table, three to four buds are needed above the ground, with no less than ½ the total length of the cutting remaining in the ground. It is better to have excessively long rather than short cuttings. Short cuttings sometimes results in desiccation of the cutting before root initiation and establishment. Cuttings must be a minimum of 18 inches in length.

F. Harvesting Wildland Cuttings: Select wildland cuttings from healthy, disease- and insect-free donor plants. Avoid donor plants exhibiting any signs of stress or poor growth. Cuttings are taken from dormant willows in late fall or early spring before the buds start to break. A very shallow cut below the outer bark should reveal green cambium indicating live tissue. Avoid stems with a discolored, wrinkled, or shrunken appearance. Lopping or pruning shears or a small saw can be used to harvest cuttings. Avoid harvesting suckers: they typically lack the carbohydrate reserves necessary to produce adventitious roots once planted. Select branches that will not impair donor plant health and appearance once removed. Remove the terminal ends of the cuttings down to a diameter and length as previously described. Remove all lateral side branches from the cuttings.

Note: A major challenge of using wildland cuttings is the coordination of timing of removal from the donor plant with optimum planting time. Cuttings root best if planted when fully dormant. Warm periods in late winter may result in early bud break, increased cutting stress during transport and storage, and ultimately reduced rooting.

G. Sealing Cuttings: Sealing the terminal (top), cut ends of cuttings helps reduce moisture loss from the cuttings. To identify the top of the cutting, find and examine lateral vegetative buds on the stem. The buds are usually above the leaf scar and point upward toward the end or tip of the branch. Dip the top 2 to 3 inches of each cutting into a 50:50 mix of white latex paint and water or paraffin wax to prevent moisture loss from the cutting.

H. Transport of Cuttings: Whether transporting cuttings to a storage facility or the planting site for installation, keep cuttings as humid (not wet) and cool as possible above freezing. During transport store cuttings in a trash bag or wrapped in light-colored, opaque plastic. Add small amounts of water to the storage sacks to prevent desiccation. Keep cuttings out of direct sunlight or in other locations where they are likely to heat up. Avoid transporting cuttings in an open pickup or trailer if heat build-up or wind desiccation is likely. Minimize transport time when possible.

I. Cutting Storage: Store in a cool, dark, humid environment at 32° to 38°F. Properly held cuttings will store well for up to 6 months. Cuttings store best under controlled environmental conditions including high relative humidity and cool air temperature. Inspect the cuttings frequently to determine condition.

J. Pre-plant Treatment of Cuttings: Soak the bottom half of the cuttings in water for 1 to 2 days prior to planting. Soaking initiates the growth process within the inner bark in willows. Cuttings should not be treated with rooting hormone, fungicide, or fertilizer.

Pre-Plant Tip: Pruning tools and saws used for removing cuttings from donor plants often crush basal tissues and reduce water uptake (See Figure A). In addition, cuttings tend to desiccate and die back some distance from the base during storage. To remove dead or damaged basal tissue, and to increase the surface area of the base of the cutting, use a very sharp grafting or cutting knife to re-cut the base of the cutting at an angle prior to insertion in the soil (See Figure B).

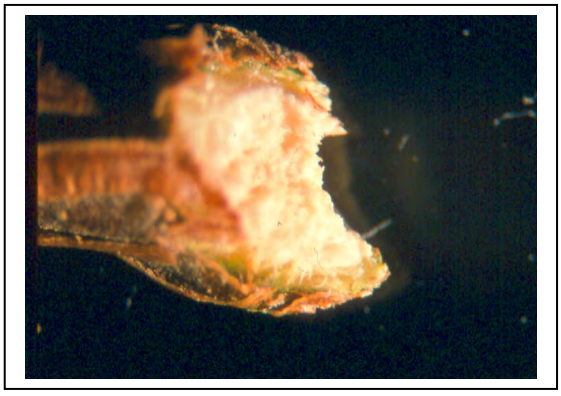

FIGURE A

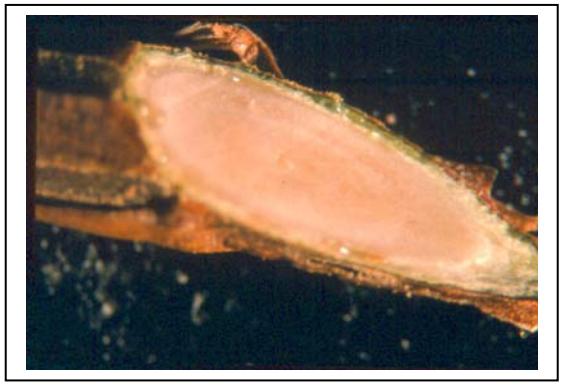

FIGURE B

K. Planting Cuttings: Plant cuttings with a shovel, rock bar, hand dibble or by merely pushing the cutting into moist soil. Maintain good soil to cutting contact by eliminating all air pockets around cutting. Eliminate air pockets by firming very moist soil around the cutting with your foot, or by adding water until the soil is saturated and slumps around the cutting. Plant cuttings deep enough so that several inches of the cutting extends into the summer water table. It is critical that un-rooted cuttings have nearly constant contact with saturated soil at the base of the cutting to meet early moisture demands until roots are developed. Un-rooted cuttings require adequate soil temperature (at least 50°F) and free water to stimulate and support adventitious rooting. Un-rooted cuttings inserted in soil too early may rot or decline in vigor before soil temperatures are adequate for root initiation. Fully dormant, properly stored cuttings allow planting flexibility and contribute to increased rooting percentage.

L. Cutting Spacing: Place shrub cuttings about 1 to 3 feet apart and tree cuttings about 6 to 12 feet apart.

M. Placement: Place cuttings at toe of slope where cutting will be in saturated soil during low water.

N. Planting Maintenance and Management: Replant dead cuttings the second and third years after installation. Monitor the site and remove any dead organic material covering cuttings. After 2 to 3 years, trim willows to stimulate smaller, denser shoot growth. Inspect plantings frequently for signs of animal damage and adjust protection accordingly. Control established herbaceous vegetation around new planting.

Where to Get Help

For more information, contact your local USDA Service Center, or Natural Resources Conservation Service or Soil and Water Conservation District office.

REFERENCES:

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